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CORRECTION

MONTHLY WEATHER REVIEW, April, 1927:

Page 190, first column, second entry under *Scientific American*, "Wood, B. Francis" should be "Dashiell, B. Francis." The author's name was erroneously published as "Wood" by the *Scientific American*.

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MONTHLY WEATHER REVIEW

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A GROUP OR CORRELATION PERIODOGRAM, WITH APPLICATION TO THE RAINFALL OF THE BRITISH ISLES

By Dinsmore Alter

[University of Kansas, Lawrence, Kans., April 22, 1927]

Recently, over a period of several years, the writer has been applying the Schuster periodogram to an analysis of the rainfall of typical sections of the world. These analyses of long records have been published from time to time, usually in the Monthly Weather Review (1). At the very completion of the last of this series of papers he conceived the idea of a different periodogram, so simple in theory that it seems incredible that it can have escaped all investigators in this field. Earlier discovery of the method would have saved him hundreds of hours of computation.

An examination, both from theory and from an extended application to the rainfall of the British Isles, leads the writer to believe that the method contains the following advantages over the Schuster method:

(*a*) About one-third the calculation will permit a closer net to be spread than is usually done with the Schuster periodogram.

(*b*) Peaks often are located more definitely and interference cuts them away more rapidly than in the former.

(*c*) Examination for reality can often, indeed in general, be made in groups instead of individually.

(*d*) In many cases it is possible to discriminate regarding the physical reality of peaks of small amplitude. This has been impossible previously.

In the following discussion time will be regarded as the independent variable, although it is obvious that any other physical variable which has a functional relationship with a second might be used to advantage in certain physical problems. Suppose that we have equidistant observed functions of the time, $q_1, q_2, q_3 \ldots q_n$. Let $q_j = q_{i+p}$; where p is the number of datum time intervals between the two q's. The data may be thought of as forming a curve with q's as ordinates and times as abscissæ. Let us match sections of the curve so that one section has been displaced by p time intervals. We shall now compute the Pearsonian correlation coefficient of these two sections and its probable error. These are:

$$r = \frac{\Sigma(\sigma_i \sigma_j)}{\sqrt{\Sigma(\sigma_i)^2 \Sigma(\sigma_j)^2}}; \quad \epsilon_r = 0.6745 \frac{1-r^2}{\sqrt{\mu}}; \quad h = \frac{r}{\epsilon_r}$$

i refers to values from the first section of curve, j to those from the second, σ_i or σ_j is the departure of a q from the mean value of its section of curve and μ is the number of pairs of q's to be compared. In conservative standard usage μ should not be less than about 75. The greater the value of μ, of course, the better and the more reliable are the results obtained. If the curves are identical, or displaced in q by a constant amount, r is one. If they are exactly opposite, r is minus one. If they have no relationship, r is zero. The value of h determines the probability of a real physical relationship, that of r how close this relationship is. h will be as large as plus three in one pair of curves out of each 48 by accident, as large as plus four in one pair out of 290. The preceding is, of course, a mere restatement of the Pearsonian coefficient theory.

It is well known, of course, that a number of students have used the correlation coefficient for the purpose of disclosing suspected periodicities in data, but these uses have been limited, it is believed, to the investigation of particular periods. The novelty of the present proposal is to apply the principles of correlation to the evaluation of correlation coefficients for a systematic number of trial periods; in other words, to construct a periodogram similar to the well-known periodogram of Schuster.

Let us now select successive integral values of p and compute r/ϵ_r for each of them. We may plot a periodogram with these ratios as ordinates and the p's as abscissæ. Unlike the Schuster periodogram, the peaks do not depend for their height on a mere sine curve of period p, but on it and on the reinforcement of all its submultiples. Strength of any one of these will give us a peak in the periodogram, and a large number of such, even though their amplitude be rather small, will reinforce each other and make their presence apparent. As soon as we pass any point of maximum in the periodogram the shorter submultiples will if present rapidly get out of phase and their interference will cause a negative correlation to follow quickly. If they are absent, the primary alone being present, the peak will be broad as in the Schuster periodogram and will be lower than it would have been for a primary of the same amplitude with the harmonics present. Since an increase in the number of products increases the ratio for any given correlation factor r, there will be a general increase in the heights of peaks for small values of p, if only short periods or if comparatively few long periods are present.

A good practical length of periodogram to compute is from a maximum value of p to give about 75 products down to one one-half that length. If individual short periodicities are desired a Fourier series may be computed very quickly for the principal peaks of the periodogram. Since angles, sines, and cosines are the same for each term of the series, we are spared the great labor of determining many independent low peaks and yet are in no danger of overlooking any period of large amplitude. The periodogram enables us to throw out large groups of such peaks without individual calculation, thus making

an enormous saving of time. It also makes practicable the use of an harmonic analyser. The computation of the periodogram is very short. With slide rule and adding machine, experience has shown that for 90 products of pairs, the ratio, giving one point of the periodogram, may be computed in about 30 to 40 minutes. Of course the sums of the squares of the residuals for the different p's are formed differentially in such speedy calculation. A periodogram of 50 points may, therefore, be calculated in about 30 hours after the data are secured. In the majority of problems the investigator will not be interested in the individual harmonics, but rather in their combined relationship, the calculation thus ending after these few hours of computation.

If one wishes to extrapolate future values from the facts secured through the data in hand it is unnecessary for him to make any calculation of phase angles unless he so desires for other purposes. Suppose that the periodogram has shown that there are certain periods x, y, z, etc., present, either as sine curves or with their harmonics. The investigator may make for each a table of the data, the first with x columns and as many rows as the data permit even using data which will not complete a row. He will take the average value in each column. These x means repeated over and over will give him the best representation of his data that he can make from the period x and its submultiples. Incidentally it will give the best prediction possible from these periods. He will then do the same for y, z, and any other peaks which he believes worthy of consideration. The results from all the periods considered are now averaged and reduced to the proper scale. In averaging, each period is given a weight equal to the number of cycles it has completed for the phase of that date. Amplitudes of the various terms are taken care of automatically by this method when we multiply the representation by the factor to adjust its mean deviation to that of the data and need not be computed for this purpose. Difficulties can arise only from submultiples which are common to two or more peaks. In general such will not be serious, but if concern is felt about them they may be subtracted easily from the final result by any of several quite obvious methods.

The accuracy of representation of the past data may easily be compared with that to be expected through accident. Let x be the number of peaks used in the representation and let y be the total number of datum values used by these peaks in representing any datum q; the quantity q has itself entered into the average, which is to represent it, x times, but, if there be no real relationship, the other $(y-x)$ points enter as accidental errors so that their sum increases as the square root of their number and equals statistically $\pm\sqrt{y-x}\epsilon$ where ϵ is the probable error of any one value of q. The sum of the y points is, therefore, $xq \pm \sqrt{y-x}\epsilon$ and the best adjustment to the q is made by dividing this by x, giving $q \pm \frac{1}{x}\sqrt{y-x}\epsilon$. The actual deviations of the representation are now found and their probable error p. The ratio H defined by the equation $H \equiv \frac{x}{\sqrt{y-x}}\frac{p}{\epsilon}$ is the factor by which residuals of the representation have been reduced from what would have been expected through mere accident and, therefore, gives an indication of the chances of successful prediction.

An investigation of the data for periods which are subject to systematic variations may be made by means of the same devices used for the Schuster Periodogram (*1a*). The limitations in this case are the same for each.

The grouping of the primary and its harmonics makes it possible, often, to investigate in a stretch of data periods which are longer than could be found if the sine curves were determined separately. Also, the rapid interference of the submultiples makes determination of their position more certain. If such shorter periods be not present we are able to carry periodicities to the lengths permissible in the Schuster method, though no farther. We have, however, even here, made a considerable saving of time.

It is obvious that if a peak in the periodogram exists mainly because of its even harmonics the periodogram will show a still higher peak at half that value, but that if it exists because of the odd harmonics there will be a large negative correlation found at that point. All harmonics contributing would tend toward a zero correlation at the half point.

As an example of the application of the method, data which already had been used in an application of the Schuster Periodogram and given as British Isles B in the tables of a previous paper (**1f**), have been analysed. The Schuster analysis had brought out a number of short periods, which because of their correspondence in periodograms computed from chronologically different stretches of data appeared to be real. All of these had been shown to be very closely harmonics of a period between 43 and 43½ years but closer to the former. This periodogram is computed for data lags of 24 to 52 years. The period of 43 years found by the Schuster method appears prominently but is not the most prominent one. The reason for this reversal is that the former calculation was made from data beginning with 1850, British Isles A of the earlier paper (*1f*). These have been extended back to 1834 and an additional station added. The first half of 1848 was unusually wet and matched with a dry half year later to give almost the maximum possible negative product, one so large that even with more than 90 products of pairs it was serious. Had it not been for this one-half year of very early data the 43-year peak would have overshadowed all the others.

We find in the periodogram three peaks which are more than three times the probable error. They are at lags of 24½, 41, and 51 years. It was noticed that these bear very simple ratios to each other, i. e., ⅗ and ⅘, respectively, to the middle one. The ratios are far more exact then the distance between computed points. This simple relationship suggested the finding of the least common multiple, in order that it might be determined whether the principal ones of the lower peaks were also harmonics. This multiple is 613 years. The fourth and fifth highest peaks are the 43 plus and the 34 year Brückner cycle. The former is represented at 43.8 by the fourteenth harmonic, a little to one side of the crest but exactly at the center of the base of this peak, and the latter is perfectly represented by the eighteenth. There are a number of peaks of low enough height that none by itself can carry any weight as being at all more than mere accident. The great success of representation of the highest peaks suggested the idea of computing all the harmonics in the range covered by the periodogram. The accuracy of the additional representation is surprising.

Of all the peaks in the periodogram only one fails to be demanded by a harmonic and only one harmonic, the twenty-fourth, does not fit a peak of some, although many times negligible, height. The two highest of these minor peaks are represented perfectly by the thirteenth and seventeenth harmonics. In only 3 out of the 14 consecutive harmonics is the error as large as 10 per cent of the interval between it and the next

nearest peak. It seems that these peaks can not be due to some one, or to a very few short periods which are harmonics of all. Undoubtedly that will account for part of the representations, but it can not for all of them.

The conclusions are that the fit is not accidental and that it can not be due to some variable cycle. The simplest explanation, though not, of course, the only possible one, is that these terms are exactly what they seem—harmonics of an irregular period of about six centuries. Whether this be the true explanation is impossible to know at the present time.

The four principal peaks are all within accidental amounts of the same height. Low peaks need, of course, not be considered in representation. Where to stop is a matter of judgment only. These four have been combined in the manner described earlier in the paper, and the accuracy of the representation is shown by Figure 2. In 88 per cent of the data the deviations are on the same

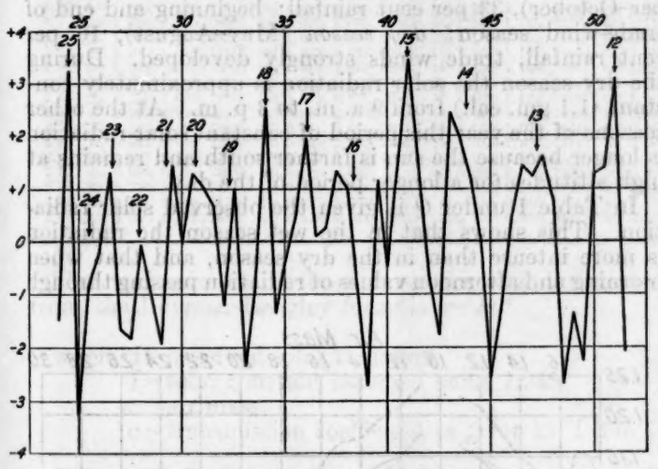

FIG. 1.—Correlation periodogram of rainfall British Isles 1834 to 1924.

side of the normal. The correlation factor between the representation and the data is +0.91.

The computation of the probability of such close representation emphasizes it still more accurately. Using the notation of a preceding paragraph, we find that for the 182 values represented, y equals 9 in 38 cases, equals 10 in 108, equals 11 in 20, and equals 12 in 16 cases. We may therefore consider y as equal to 10 throughout the whole of the curve. x equals 4, the number of peaks used.

We compute $p=4.6$; $\epsilon=10.5$; $H=0.71$. The reduction in size of the residuals from that demanded by error theory to 71 per cent of that value is great enough that we may feel rather confident that the correlation between the extrapolated part of our curve and the data yet to be observed will be positive. Whether it will be sufficiently large to have other than academic interest is a matter on which the writer will hazard no opinion. *The future values are given for test purposes only.* Since they result from the combination of four cycles, they should carry more weight than the test values given in the previous paper, which depended entirely on but one of these.

The writer wishes to acknowledge the grant from the research committee of the University of Kansas under which a large part of the computing was done and the excellent service of Mr. James O. Edson, who was engaged to perform it.

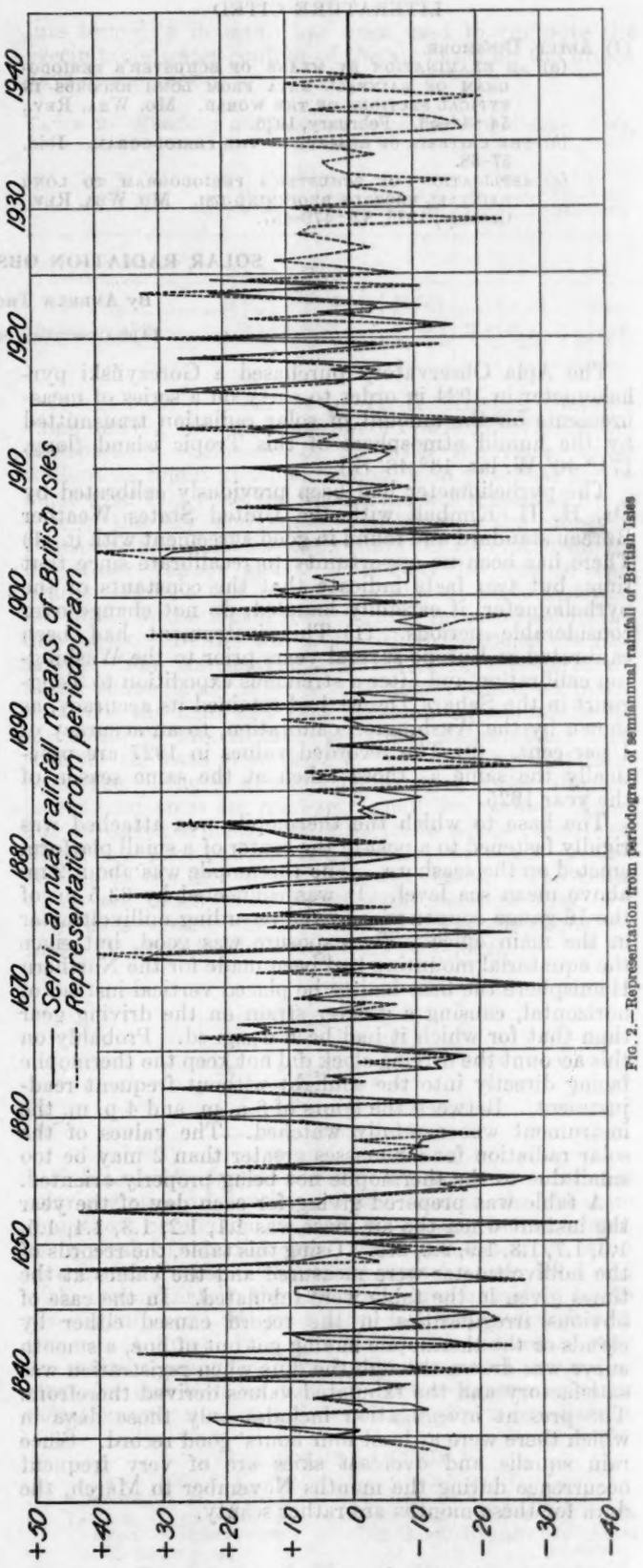

FIG. 2.—Representation from periodogram of semiannual rainfall of British Isles

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SOLAR RADIATION OBSERVATIONS AT APIA, SAMOA

By ANDREW THOMSON, Director

[Apia Observatory, Samoa, May 19, 1927]

The Apia Observatory purchased a Gorczyński pyrheliometer in 1924 in order to carry on a series of measurements on the amount of solar radiation transmitted by the humid atmosphere of this Tropic island (long. 171° 46′ W. lat. 13° 48′ S.).

The pyrheliometer had been previously calibrated by Dr. H. H. Kimball with the United States Weather Bureau standard and found in good agreement with it. (1) There has been no opportunity to recalibrate since that time, but two facts indicate that the constants of the pyrheliometer, if carefully handled, do not change over considerable periods. (1) This instrument had been calibrated in Europe several years prior to the Washington calibration and after a strenuous expedition to Touggourt in the Sahara Desert had retained its accuracy, as shown by the Washington calibration, to an accuracy of 1 per cent. (2) The recorded values in 1927 are practically the same as those taken at the same season of the year 1925.

The base to which the thermopile was attached was rigidly fastened to a post in the center of a small platform erected on the seashore. The thermopile was about 2 m. above mean sea level. It was connected by 33.5 m. of the 16-gauge copper wire to the recording millivoltmeter in the main office. The exposure was good, but since the equatorial mounting had been made for the Northern Hemisphere the base had to be placed vertical instead of horizontal, causing a greater strain on the driving gear than that for which it had been designed. Probably on this account the driving clock did not keep the thermopile facing directly into the sunlight without frequent readjustment. Between the hours of 8 a. m. and 4 p. m. the instrument was carefully watched. The values of the solar radiation for air masses greater than 2 may be too small due to the thermopile not being properly oriented.

A table was prepared giving for each day of the year the instant when the air mass was 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, etc. Using this table, the records of the millivoltmeter were measured and the values at the times given in the table were tabulated. In the case of obvious irregularities in the record caused either by clouds or the thermopile having got out of line, a smooth curve was drawn through the dots when registration was satisfactory and the tabulated values derived therefrom. The present investigation includes only those days in which there were at least four hours' good record. Since rain squalls and overcast skies are of very frequent occurrence during the months November to March, the data for these months are rather scanty.

In Samoa the year may be divided into three seasons—*wet season* (November–February), 51 per cent rainfall, trade winds irregular; *equinoctial* (March–April, September–October), 33 per cent rainfall; beginning and end of trade-wind season; *dry season* (May–August), 16 per cent rainfall, trade winds strongly developed. During the dry season the solar radiation is approximately constant (1.1 gm. cal.) from 9 a. m. to 3 p. m. At the other seasons of the year this period of constant solar radiation is longer because the sun is farther south and remains at high altitudes for a longer period of the day.

In Table 1 under Q is given the observed solar radiation. This shows that in the wet season the radiation is more intense than in the dry season, and that when morning and afternoon values of radiation passing through

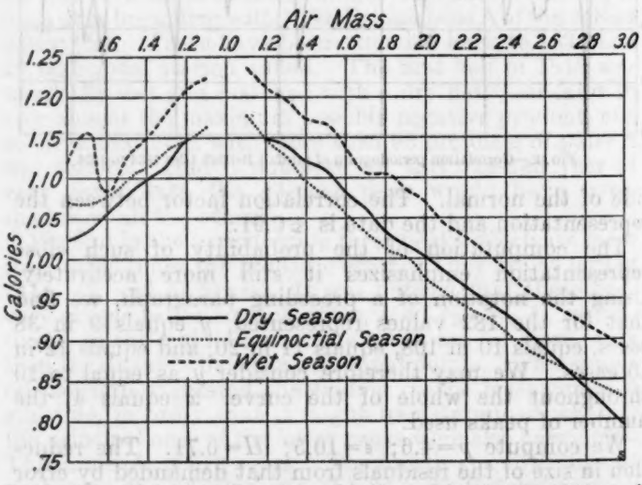

FIG. 1.—Solar radiation intensity, sat normal incidence, reduced to mean distance of the earth from the sun. (Gram-calories per minute per square centimeter)

the same air mass are compared during the wet and dry seasons the afternoon values are the greater, but in the equinoctial months the morning values are the greater.

During the dry season the earth is at a greater distance from the sun than in the wet season, so that before comparing the transparency of the atmosphere it is necessary to adjust the values of Q to unit distance. The dry season values were multiplied by 1.028, the wet season by 0.973, and the equinoctial values were unchanged. As shown by the values of Q' in Table 1 and Figure 1, the radiation values are uniformly higher in the wet season.

TABLE 1.—*Summary of solar radiation observations at Apia, Samoa*

[Q = measured radiation intensity and Q' = the intensity reduced to mean distance of the earth from the sun, expressed in gram-calories per minute per square centimeter; a = atmospheric transmission coefficient]

Air mass	Dry season				Equinoctial season				Wet season				Year	
	No. obs.	Q	Q'	a	No. obs.	Q	Q'	a	No. obs.	Q	Q'	a	No. obs.	Q
A. M.		cal.	cal.			cal.	cal.			cal.	cal.			cal.
1.8	19	0.996	1.024	.7015	6	1.071	1.071	.7193	3	1.151	1.120	.7372	28	1.073
1.7	20	1.007	1.035	.6913	11	1.069	1.069	.7047	5	1.188	1.156	.7379	36	1.088
1.6	21	1.028	1.057	.6846	14	1.078	1.078	.6931	8	1.115	1.085	.6958	43	1.074
1.5	23	1.021	1.050	.6641	16	1.099	1.099	.6850	12	1.156	1.125	.6958	51	1.092
1.4	25	1.067	1.097	.6660	19	1.112	1.112	.6703	14	1.182	1.150	.6888	58	1.120
1.3	24	1.085	1.115	.6536	19	1.135	1.135	.6625	14	1.214	1.181	.6786	57	1.145
1.2	8	1.117	1.148	.6463	19	1.147	1.147	.6460	14	1.244	1.210	.6753	41	1.169
1.1					18	1.163	1.163	.6386	15	1.258	1.224	.6584	33	1.210
P. M.														
1.1					21	1.177	1.177	.6355	14	1.271	1.237	.6648	35	1.224
1.2	8	1.117	1.148	.6463	24	1.147	1.147	.6460	15	1.246	1.212	.6762	47	1.170
1.3	25	1.107	1.140	.6516	24	1.122	1.122	.6555	16	1.230	1.197	.6902	65	1.153
1.4	26	1.090	1.120	.6761	24	1.096	1.096	.6654	16	1.207	1.174	.6914	66	1.131
1.5	26	1.069	1.109	.6850	24	1.076	1.076	.6755	15	1.198	1.166	.7127	65	1.114
1.6	26	1.051	1.080	.6922	24	1.055	1.055	.6837	15	1.170	1.138	.7168	65	1.092
1.7	26	1.032	1.061	.7016	24	1.032	1.032	.6902	15	1.136	1.105	.7186	65	1.067
1.8	26	1.005	1.033	.7050	24	1.012	1.012	.6970	14	1.136	1.105	.7451	64	1.051
1.9	26	0.991	1.017	.7122	23	1.003	1.003	.7070	13	1.115	1.085	.7440	62	1.036
2.0	26	0.975	1.002	.7191	22	0.975	0.975	.7088	13	1.099	1.069	.7423	61	1.016
2.1	26	0.957	0.984	.7241	22	0.957	0.957	.7145	13	1.071	1.042	.7442	61	0.995
2.2	26	0.941	0.967	.7281	22	0.941	0.941	.7200	13	1.055	1.027	.7494	61	0.979
2.3	26	0.922	0.948	.7295	21	0.929	0.929	.7263	13	1.035	1.007	.7551	60	0.962
2.4	26	0.906	0.931	.7367	21	0.909	0.909	.7291	13	1.014	0.987	.7549	60	0.943
2.5	26	0.886	0.911	.7393	21	0.888	0.888	.7318	13	0.993	0.966	.7562	60	0.922
3.0	23	0.774	0.796	.7433	19	0.828	0.828	.7532	11	0.915	0.890	.7716	53	0.839
4.0	20	0.668	0.687	.7720	15	0.737	0.737	.7852	6	0.880	0.856	.8151	41	0.762
5.0	19	0.556	0.572	.7834	14	0.618	0.618	.7956	5	0.839	0.816	.8412	38	0.671

The transmission of the atmosphere was determined from the Bouguer-Langley formula $i = Ia^m$

where i = observed solar radiation.
I = solar constant assumed value 1.938.
m = air mass.
a = transmission coefficient as given in Table 1.

This formula is strictly correct for monochromatic radiation only, and for that reason the value of a varies with m.

In both the dry and the wet seasons the afternoon values of the transmission coefficient (see fig. 2) are

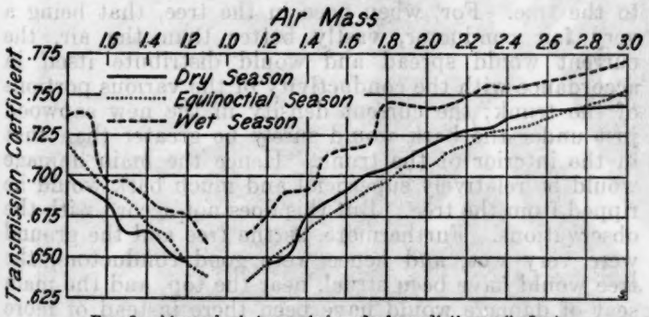

FIG. 2.—Atmospheric transmission of solar radiation, a ($i = Ia^m$)

greater than the morning, while in the equinoctial months it is greater in the morning. This latter condition might have been expected to persist throughout the year, as the absolute humidity is less in the morning hours than in the afternoon.

The observations were necessarily taken on clear days, so that the data given by O. Tetens and F. Linke (2) for absolute humidity on bright (heitere) days may be considered as applying very closely to those days on which the pyrheliometer records were obtained. Fowle's formula (that the depth of water in cm. equals 0.23 × absolute humidity in mm.) has been used to compute the precipitable water content of the air based on the bright days of the year.

TABLE 2.—*Humidity and moisture content on bright days, Apia, Samoa*

Local time	8h–9h	9h–10h	10h–11h	11h–12h	12h–13h	13h–14h	14h–15h	15h–16h	16h–17h
Approximate air mass:									
January	1.9–1.4	1.4–1.1	1.1						
June	2.8–1.8	1.8–1.4	1.4–1.3	1.3–1.3	1.3				
Absolute humidity	19.1	19.8	21.0	21.2	22.4	22.4	21.8	22.2	21.8
Moisture content	4.39	4.55	4.83	4.88	5.15	5.15	5.01	5.11	5.01

It has been pointed out by H. H. Kimball that the value derived from an extension of Fowle's curves for the transparency coefficient of air with the same water content as found at Apia, Samoa, is in practical agreement with that observed during the wet season at Apia. During the dry and equinoctial seasons the observed transparencies were less than could be accounted for by the water vapour alone. This may be due to two causes: (1) The salt particles in the air such as Owen has found in the North Atlantic may be increased in the dry season. In the wet season these particles are dissolved. The transparency for visual rays is certainly better immediately after a rain shower when on many occasions the light and dark areas on the mountainside of Savaii, 60 km. distant, are easily discernible. This is never the case after three or four days without rain. Since the seeing is almost entirely over water and adjacent land areas are relatively small the haziness is not due to dust particles. (2) The trade winds have been shown by pilot-balloon observations to reach greater heights in the dry than in the wet season. The trade winds are much more laden with moisture than the antitrades above them. From kite observations F. Linke (3) gives the following data as typical.

Height	Relative humidity	Wind
Meters	*Per cent*	
0	65	E. S. E.
1,300	90	
2,800	6	E. to E. N. E

F. Linke (4) found notably higher values for the solar radiation in Southeast trade wind in the Atlantic than those here given for Apia, which may be considered as typical of conditions in the Southeast trade wind area in the Pacific. For an air mass 1 at sea level and with approximately the same absolute humidity Linke gives a value of 1.464 gm. cal. to be compared with 1.21 gm. cal. at Apia. It is doubtful if this difference may be entirely accounted for by instrumental error but must be ascribed, in part, to better transmission of radiation over the South Atlantic than the South Pacific.

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UNIQUE DESTRUCTION OF A TULIP TREE BY LIGHTNING

By FRANK P. NORBURY, Cooperative Observer

[Jacksonville, Ill., April, 1927]

In the afternoon, about 4:30 o'clock, April 13, 1927, there occurred a thunderstorm at Jacksonville, Ill., a feature of which was the destruction by lightning of a tulip tree standing on the lawn of Hon. Fred H. Rowe. This tree, approximately 125 feet in height, with a base girth of 12 feet, stood in a group of trees distributed on the lawn and the adjacent Duncan Park. It was beginning to bud. It was wet from the rain and the ground thoroughly saturated by the heavy rains of the preceding three weeks. The bolt shattered the tree, causing what appeared to be an explosion, centered in the middle third of the trunk. The photographs show the lower third standing, rent in strips from above downward. The middle third was torn in shreds and strips, excepting a branch extending on the east side, which was severed and propelled fully 25 feet from the main trunk. Strips from the middle third, some measuring 5 and 10 feet in length, were thrown 100 to 200 feet away from the base. Smaller pieces were found even farther away. It is to be noted that very little débris was to be seen. (This is due to the nature of the wood of the tulip tree.) That the disruption was explosive in kind, like that of a firecracker, is confirmed by the observance of a neighbor who chanced to be looking out of the window at the turbulent storm. She said, "that following the stroke the tree trunk flew asunder." There were flares of light circumscribing the trunk, followed by a cloud of smoke, mingled with what appeared as steam. There was little evidence of combustion, but the smell of smoke extended north to the near residences. One neighbor thought her home had been fired by the lightning, as she smelled the smoke. To confirm the probability of explosive force the middle third was so completely shattered that the upper third when torn off fell and lodged in the shattered remains of the lower third, as shown in the photograph. The extent of disruption suggests explosion, which probably was due to the generation of steam, made possible by the intense heat liberated by the positive charged bolt in its contact with the grounded and negative charged tree. It is probable that the inherent qualities of the tulip tree may have been a factor in the phenomena of this unique disruption. This tree was a beautiful specimen of the species (*Liodendron tulipifera*) to be found in central North America, the characteristics of which are absolutely straight, symmetrical, and tapering trunk, with diverging branches, sweeping upward. Its wood is classed among the light woods and has a compact grain. It is a wood that absorbs moisture readily and, like the poplar and cottonwood, will shrink and warp. In the live state "it is full of sap," as its foliage indicates, being very glossy and bright green. Because of its texture, its ability to absorb moisture, and its symmetrical and tall trunk may be noted the factors which account for the peculiar explosive disruption, as shown in the photographs.

LIGHTNING

N. ERNEST DORSEY

[National Research Council, Washington, June 17, 1927]

The editor of the REVIEW has kindly permitted me to study the original prints of Doctor Norbury's very interesting photographs of the blasted tree that forms the subject of the preceding note. Four views are shown, one of which is reproduced above. They reveal several things that seem worthy of careful attention, especially as it is difficult to reconcile them with the commonly accepted ideas regarding the nature of lightning: (1) The seat of the explosion was evidently situated deep in the trunk, otherwise the trunk would not have been so completely shattered, and it was well below the center of the tree. (2) In none of the photographs is there any indication that bark was significantly stripped from the trunk. No pieces of bark can be distinguished among the débris, and in every photograph an examination with a lens shows that those outer splinters that are suitably situated for observation still are covered with apparently undamaged bark. (3) The long upper portion of the trunk, which is seen leaning against the shattered stump, is only slightly damaged, and that damage is superficial and limited to a narrow strip extending (as shown in another photograph) from the butt to beyond the limits of the photograph. The damaged portion is broadest and apparently deepest at the butt and becomes narrower and more superficial as the top of the photograph is approached. It runs parallel with the trunk from the butt to a point hidden by the shattered stump and then begins to spiral gently around the trunk. It would be interesting to know whether the grain of that portion of the trunk is likewise spiral.

It is difficult to reconcile these facts with the commonly accepted idea that we are here concerned with an ordinary current of electricity passing through the air, to the tree, and through that to the ground, the explosion being due to vapors generated in the tree by the heat produced by the passage of the current. Were this the proper explanation, the greatest density of current, and consequently the greatest heating and the greatest damage, would be where the current passes from the air to the tree. For, when once in the tree, that being a very fair conductor, vastly better than the air, the current would spread and would distribute itself in accordance with the conductivity of the various portions of the trunk; the current density in the new sapwood just under the bark would surely be greater than that in the interior of the trunk. Hence the main damage would be relatively superficial and much bark would be ripped from the tree. But this does not accord with the observations. Furthermore, as the tree and the ground were very wet, and hence were good conductors, the tree would have been struck near the top, and the main seat of damage would have been there instead of more than halfway down. If the narrow strip of damage extending along the upper section of the tree is regarded as evidence that the bolt did actually strike the tree near its top, then it is necessary to answer the question: How is it possible for the bolt to have passed down more than half the length of the trunk, damaging only a narrow, superficial region, and then by means of a deep-seated explosion to have completely blasted a lower, but not lowest, portion of the trunk? It seems impossible. If the stroke came down along this strip, then surely the explosion was not produced directly by the stroke, but arose from some secondary effect. If the bolt raised the tree to a very high positive potential,

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the explosion perhaps resulted from a secondary electronic dart initiated by a stray electron which happened to be near the tree, but this does not seem very probable.

From a close study of a similar case,[1] but one in which the explosion was much less violent, I was led to propose the electronic dart hypothesis,[2] which seems to explain many of the queer facts which have been recorded. This hypothesis is based upon the following well-known facts. (1) There are always some free electrons scattered through the atmosphere. (2) When subjected to an electric field of an intensity that can readily be secured in a laboratory these electrons acquire sufficient energy to enable them to dislodge an electron from each atom with which they collide. In still more intense fields they will acquire in a given time more energy than they expend. In such fields, if maintained, they may attain an exceedingly high velocity. (3) Each electron freed from an atom behaves likewise. Thus a single free electron may give rise to a great swarm of electrons traveling through the field at a high velocity. Under the combined action of the field and of the mutual repulsion of the constituent electrons, such a swarm will become elongated in the direction of motion. This elongated swarm may be described as a dart of electrons. (4) While traveling at a high velocity, the resulting magnetic field confers upon the electrons a great inertia, and gives rise to forces which largely neutralize the mutual electrostatic repulsion of the constituent electrons, thus permitting them to keep together.

On the dart hypothesis, a lightning stroke of the type that produced the damage under study consists of such an electronic dart traveling at a tremendous velocity. When it strikes a tree it penetrates to a certain distance before its forward velocity is arrested. As the forward velocity is reduced, the magnetic field is likewise reduced, the mutual repulsion of the electrons becomes rapidly more effective, and they tend to spread in all directions, up and sidewise as well as down. The electrons become attached to the atoms of the tree, and these greatly impede their progress; hence, the tree is subjected to great strains of electrostatic origin. In the case studied there was a small, definitely bounded column of shredded fibers extending along the grain in both directions from the center of explosion, indicating that the electrons, presumably after becoming loaded with atoms, passed in those directions, but there was no indication that they passed across the grain. It appeared that the resistance to their passage in that direction was so great that in their attempt to pass they rent the tree asunder before they penetrated in sufficient numbers to leave a visible trail of damaged fibers. As the electrons spread their mutual repulsion decreases, and consequently their ability to cause damage does likewise; hence, in passing along the grain from the center of explosion, whether up or down, the extent of the damage decreases. This agrees with the observations.

The higher velocity of a dart the greater is its inertia and the less is its path affected by the presence of conductors or of other charged bodies. It strikes a certain point mainly because that point happens to lie in its path. That the striking of an object by lightning may have nothing to do with the ability of that object to facilitate the passage of the charge to earth is well illustrated by the case of the flagstaff on the old four-story, brick building at 1701 Pennsylvania Avenue, Washington, D. C., which was struck on the afternoon of August 17, 1926. The staff was of wood, old, well seasoned, painted, sound, and very light. A column of shredded fibers about an inch beneath the surface extended along the grain from a point about 9 inches below the top of the staff to a point about 4 feet above the iron collar which surrounded the staff 6 feet above the roof and which was attached to the metal roof by three iron rods, forming a tripod. The top 6 inches of the staff was merely split; below the lower end of the shredded column splinters were split off, but the lower 9 feet of the staff was entirely undamaged. The lowest portion of the damage was 3 feet *above* the supporting collar. There was no evidence that the bolt touched the supporting collar, its tripod, the roof, or a neighboring chimney, perhaps 6 feet distant. A few pieces were simply bitten from the side of the staff and thrown to the street. They were removed before they could be examined. These peculiarities are entirely normal on the dart hypothesis, but seem paradoxical on the theory commonly accepted. In view of the evidently large amount of air which was contained in the pores, it is difficult to see how the vaporization of the small amount of moisture in them could have given rise to sufficient pressure to have caused the damage.

In a recent attempt[3] to prove theoretically that a lightning stroke can not consist in the advance of a negative charge, the characteristics of such electronic darts as we have here postulated were not considered. Hence, in reference to the dart hypothesis, the proof advanced is irrelevant. Furthermore, it seems to be inextricably bound up with the assumption that the electrical field at the tip of an advancing stroke has, at least roughly, a spherical symmetry, the force diverging in all directions from the tip. It is difficult to see how this can be true in any actual case, except possibly at those points at which the advance is checked. The article is so vague that it is impossible to determine on what grounds the author based the assumption.

In the same article the extreme rarity of photographs showing strokes that appear to have branches pointing from the ground is advanced as proof that strokes corresponding to a negatively charged cloud are exceedingly rare. Mere rarity is for our present purposes irrelevant, as we are considering only a particular stroke. But it should be noticed that the proof advanced rests upon the tacit assumption that all strokes correspond to the advance of a positive charge, or that the frequency with which negative strokes, if existent, are branched is essentially the same as that for positive strokes. Neither assumption is necessarily true. On the dart hypothesis there are strokes corresponding to the advance of a negative charge, and the positive strokes should be branched much more frequently than negative ones. On this hypothesis a positive stroke[4] advances by a series of steps depending upon the occurrence of free electrons, each of which participates by giving rise to a dart shooting from without, and somewhat in advance, into the stroke. The electrons run in the direction in which the field increases, a condition favorable to the formation of a powerful dart. Each dart leaves a trail of positively charged atomic residues, and thus extends the positive stroke. The stroke advances by accretions from without, and these may come from the side as well as from the main line of advance, depending upon the distribution of stray free electrons. Branching is to be expected. On the other hand, a negative stroke advances in a mighty rush until the field, the raindrops, or other material encountered by it causes a temporary halt; then it starts

[1] Dorsey, N. E.: MONTHLY WEATHER REVIEW, 53: 479–483, 1925; Journ, Washington Acad Sci., 16: 87–93, 1926 (some misprints).
[2] Dorsey, N. E.: Journ. Franklin Inst., 201: 485–496, 1926.
[3] Simpson, G. C.: Proc. Roy. Soc. A, 111: 56–67, 1926; *cf.* Nature, 118: 190, 481, 1926.
[4] *cf.* Dorsey, N. E.: Nature, 118: 190, 482, 1926.

off again in another rush. Furthermore, an electron suitably situated for the formation of branch will run away from the bolt into an ever-decreasing field, a condition adverse to the formation of a powerful dart. If branches occur they will probably be very few and weak, except in the neighborhood of a temporary or permanent halt. There the field becomes exceedingly great, and thence branches may radiate in many directions. Star-like branching is observed and has been photographed, but whether it is real or the result of extreme foreshortening, the direction of the main trunk being very straight and coinciding with the line of sight through the center of the star, I am unprepared to say. Such a star may be seen to the left in the photograph published by Doctor Hoffert in 1890.[5]

[5] Hoffert, H. H.: Proc. Phys. Soc., 10: 176-179, 1890; Boys, C. V.: Nature, 118: 749, 1926.

Types of lightning that can not be satisfactorily explained by an extension of the dart hypothesis probably exist. For example, in multiple strokes those subsequent to the first probably involve much lower field intensities and are more like ordinary discharges through an ionized gas; ball lightning seems certainly to require a quite different explanation. In order to disentangle the various types it is necessary to study in detail actual flashes and their effects. These must be studied individually and be carefully classified. To bunch them and to discuss average effects will get us nowhere. In this study the effects of minor strokes are of great value, as they will probably yield more detailed information than can be obtained from those of the more spectacular ones. The latter are likely to be complicated by secondary effects, and precious evidence may be destroyed by the violence which characterizes them.

TORNADO OF JUNE 3, 1927, NEAR TOPEKA, KANS.

By S. D. FLORA, Meteorologist

[Weather Bureau, Topeka, Kans.]

A small tornado struck the southwestern suburbs of Topeka one-half mile southwest of the Country Club, about 4:40 p. m. of June 3 and traveled slightly north of east for a distance of 2½ miles before its last damage was done. The long, pendant cloud was sighted 3 miles east of its origin, but apparently did not reach the ground after traveling so far. The path of destruction, which was well defined, was about 100 feet wide.

No one was injured, and the total property damage was estimated at $400. A house near the point where the storm first struck had its roof badly damaged, and the barn, about 50 feet west of the residence, was wrecked, parts of it apparently being carried entirely over the residence and distributed over a field in the east. Some of the wreckage landed in a tree top just east of the house.

The storm passed over the southern outskirts of Topeka with very little damage, except that just noted, and slight damage to a greenhouse, to a few shade trees, and an occasional outhouse.

The storm followed a light fall of hail and came with a terrific roaring. The characteristic cloud of the tornado was seen by a number of persons.

A curious freak of the violence of the wind was a 2 by 4 pine rafter of a barn that was driven entirely through the siding and 2-inch wall of a near-by house without any battering of the pointed end of the rafter.

TORNADO AT AUBURN, KANS., JUNE 3, 1927

By EDWARD C. CORKILL, Junior Observer

[Weather Bureau, Topeka, Kans.]

The small tornado which struck Auburn, Kans., a small town about 18 miles southwest of Topeka, was seen to form about 1 mile west of Auburn by two clouds, one a black one coming from the north and a nearly white cloud coming from the south. When they met they began to whirl and turn to a dark gray color, making a very loud roar, and move eastward very rapidly.

From this cloud two distinct funnel-shaped clouds were seen to emerge and strike the ground and pick up several small trees and brush that was piled; one of the trees was carried for over a mile before it was dropped. When the tornado hit a timber about one-half mile west of Auburn it uprooted about a half dozen elm trees, varying from 12 to 24 inches in diameter, and one was split in the center for about 12 feet—this due to the twisting motion.

From here the funnel-shaped clouds lifted for a moment, but dipped to the ground again, striking a steel windmill and twisted the wheel around the tower so that it had to be removed for repair. They broke several shade trees and tore shingles from houses on either side of the street, but did not disturb the trees growing close to the street, showing that the two funnel-shaped clouds traveled in very nearly parallel courses about 100 to 150 feet apart.

Each of the funnel-shaped clouds was about 50 to 100 feet in diameter at the lower part and seemed to dip to the ground at about the same time. The third time they struck the north one tore shingles off of the school building and tore an entrance hall to the basement off, blowing it into five sections, and was seen to hurl it into the air about 75 feet before dropping it. Two or three small buildings around the school building were wrecked, also several large maple trees were broken off by the south funnel-shaped cloud.

Thence the path of the funnel-shaped clouds was through an orchard and to a farmyard where the south one completely wrecked a barn, but hurt none of the six head of livestock which were all in the barn. The stall in which one horse was tied was all that was left standing. Most of the roof was hurled into a hedge fence, which was partly uprooted.

The storm was accompanied by a terrific roaring and heavy rain but very little hail. The time of occurrence was about 6:30 p. m., and the tornado clouds lasted for only a few minutes before they united and dissipated about one-half mile east of Auburn. The course was a little north of east. The total damage was estimated at about $1,000. No lives were lost and no one injured. One peculiarity of the tornado was that the two funnel-shaped clouds emerged from the same cloud and struck at about the same time.

NOTES AND ABSTRACTS

Professor Édouard Brückner, 1862-1927 [1]

We regret to learn of the death of Prof. Édouard Brückner, on May 21 at the age of 64 years. Professor Brückner is well known to all meteorologists from the weather cycle of about 35 years which bears his name, and which is probably the best-founded of all meteorological periodicities. It is stated that he discovered this cycle in 1887; apparently it was known several centuries before, for it is mentioned by Sir Francis Bacon, but until Brückner published in 1890 his noteworthy compilation "Klimaschwankungen seit 1700" it had never been scientifically demonstrated. Among his other meteorological publications may be mentioned his "Berichten über den Fortschritt der geographischen Meteorologie" (1891, 1894, 1899); Einfluss der Schneedecke auf das Klima der Alpen" (1893) and Klimaschwankungen 1813–1912 in Vorderindien (1918).

E. Brückner was born at Jena on July 29, 1862, his father being Alexander Brückner the historian, which perhaps accounts for his able treatment of historical sources in "Klimaschwankungen." He received the degree of Ph. D. at Munich in 1885, and from 1886 to 1888 he was assistant editor of the Meteorologische Zeitschrift. His work was not mainly meteorological, however, for in 1891 he became professor of geography at Bern, and in 1906 professor of geography at Vienna, which post he held until his death, and he did a great deal to explore the boundary science of geology and meteorology which is known as paleoclimatology. He collaborated with A. Penck in studying the Quaternary history of the Alps, a fortunate association which produced "Die Alpen in Eiszeitalter," three large volumes published between 1901 and 1909 providing at once the first sure proof of the succession of glacial advances and retreats, a nomenclature which is firmly rooted in the literature of glacialogy, and a model of painstaking exploration, critical comparison and lucid exposition.

CAUSES OF TROPICAL RAINFALL

[Reprinted from *Nature*, London, July 9, 1927, p. 62]

The rainfall of the Sudan, both west and east, has been found to fluctuate considerably from year to year, not infrequently to such an extent that deficiency or irregularity leads to famine.

In discussing the causes for this in a paper in *Matériaux pour l'étude des calamités* (No. 11, 1926), G. T. Renner maintained that all tropical rainfall is really monsoonal in character. During the period of high sun, the land masses are centers of low pressure surrounded on sea and land by areas of higher pressure. Monsoonal currents blowing from the sea into these areas of low pressure bring heavy rainfall. The alternate cooling of the tropical lands, when the sun is low, leads to a high pressure and a dry season. The double rainy season of equatorial regions is caused by those areas being crossed by both sets of monsoonal currents. Thus variations in the rainfall of the Sudan are due to variations in the intensity of the low pressure and the resultant strength of the monsoon currents. Variation in solar weather must cause the variation in the intensity of the low pressure.

Mr. Renner further points out that while all tropical rainfall is liable to vary from year to year, it is only in the savanna and grassland regions, where normal rainfall makes agriculture possible, that a marked deficiency leads to famine conditions. He thus considers that all the tropical savannas and grasslands are potential famine areas.

THE WEATHER AT BRUSSELS (UCCLE) DURING THE MONTHS OF APRIL AND MAY, 1927 [2]

By E. VANDERLINDEN

April.—During almost all of the first half of April, Europe lay under the influence of low pressure, which appeared at the close of March and later extended over the greater part of the continent; barometric minima were noted in our region on the 2d and 10th. The anticyclone that afterward overspread the southern half of the continent until about the 22d began to invade Europe after the 12th and the region of low pressure was pushed back toward the north. Following the retreat of the anticyclonic belt toward the south the region of low pressure began to spread in the same direction after the 22d, the center remaining generally over Scandinavia or the Baltic Sea, or then in that vicinity. This barometric situation gave us as the predominating condition light to moderate winds from points between southwest and northwest; these were often cool and rarely warm, as the component was northerly or southerly.

Excepting the period from the 18th to the 22d, which was fine and warm (means of maxima and minima 18.5° C. and 6.3° C., normals 14.2° C. and 4.3° C., respectively), the temperature generally presented only slight departures, positive and negative, from the normal; colder weather prevailed after the 24th. For the month the mean maximum was 14.0° C. and the mean minimum 4.7° C. (normals 13.7° C. and 3.9° C., respectively). The highest temperature, 19.7° C., occurred on the 19th and again on the 21st, the lowest temperature, −0.5° C., was recorded on the 27th, the only day in the month with freezing temperature. White frosts were frequent; on the night of the 26th–27th the grass thermometer at Uccle registered −8° C.

The total duration of sunshine was 130 hours (normal 165 hours). The total precipitation was 67 mm. (normal 58 mm.) distributed over 18 days with appreciable amount; in the first half of the month the precipitation was 49 mm. on 13 rainy days.

May.—An area of barometric depression, not very deep, extending from the British Isles to the Mediterranean Sea, remained over western Europe during almost all of the first decade of May. This period was warm with light, variable winds. The high pressure that overlay Russia at the same time began to recede toward the east after the 8th, and a depression from the north spread over the north of that country, while an anticyclone, also from the north, advanced over western Europe. From the 11th to the 13th the barometric maximum remained in the vicinity of Iceland or of the British Isles. From the 15th to the 19th a barometric minimum moved from Iceland over Russia while an anticyclonic area, oriented northwest-southeast partially covered western Europe. This high pressure remained until about the 26th and later moved northward. In the last two decades the winds were from northwest to northeast; they were generally cold and dry. This condition was changed only toward the close of the month, when a rather uniform area of barometric depression advanced over the western

[1] Reprinted from Meteorological Magazine, June, 1927, p. 118.

[2] *Ciel et Terre*. June, 1927. Brussels.

part of the continent and there came with it warm, moist winds and stormy weather.

The weather was warm from the 1st to the 9th and again on the 30th and 31st (means of maxima and minima 22.5° C. and 9.1° C., normals 17.6° C. and 7.0° C.), while the remainder of the month was cold, chiefly at night due to intense radiation (means of maxima and minima 16.9° C. and 4.8° C., normals 19.2° C. and 8.2° C.). For the entire month the means of maxima and minima were 18.9° C. and 6.3° C. (normals 18.7° C. and 7.8° C., respectively). The highest temperature, 25.7° C., was recorded on the 4th and again on the 7th, the lowest temperature was −1.5° C. on the 12th. This freeze and the frequent white frosts were extremely damaging. In general, there was little cloudiness; the total number of hours of sunshine was 222 (normal 220). The first and second decades were especially sunny.

The precipitation was light; the 10 days with measurable amount gave only 34 mm. (normal 57 mm.), 24 mm. falling on the 30th and 31st. Toward the close of the month the dryness had become distressing to agriculture.—*Transl. W. W. R.*

SOLAR RADIATION AND RAINFALL IN THE SOUTHERN REGION OF CHILE

By JULIO BUSTOS NAVARRETE, Director

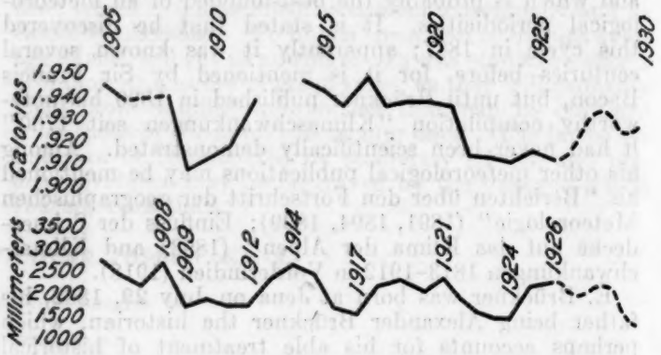
[El Salto Observatory, Santiago, Chile, May, 1927]

* * * In our investigations we have constructed two graphs; one showing solar activity and rainfall from 1850 to 1926 and another showing solar radiation and rainfall from 1905 to 1926. The second graph, notwithstanding the fact that it relates to a shorter period, is the more interesting in that it contains exact data on solar radiation, measured in calories, and complete observations, without break in continuity, of rainfall at Valdivia.

From the year 1900 to date there has been observed a periodicity of 7 to 10 years in the rainfall of the southern region of Chile. The most important minima occurred in 1903, 1909–1912, 1917, and 1924. The maxima, however, have a march somewhat less regular, yet they, too, presnt a visible periodicity, the most important of the maxima being observed in 1908, 1914, 1921, and 1926 or 1927. The period appears to be a little shorter on resolving some maxima into two secondary maxima as is observed in the "double" period of the central region of Chile.

In our graph of solar radiation and rainfall in the southern region of Chile from 1905 to 1926 there can be clearly observed a manifest relation between the annual variation (variation from year to year) of solar radiation and that of rainfall at Valdivia. The minimum (of solar radiation) in 1909 coincides with a rather marked minimum of rainfall in the same year and this (condition) continues in the years (immediately) following; the maximum of 1914 coincides with a maximum of rainfall in the same year. The secondary (minimum) fall in 1916 produced, however, an exaggerated effect, the two years 1916 and 1917 being relatively dry; the increased radiation from 1917 to 1921 marks another (a new) rainy period that is well defined; the minimum of 1923 and 1924 coincides with a well marked minimum of rainfall; and, finally, the increase in solar radiation recently observed coincides, also, with the increase in rainfall in the southern region.

At present the southern region is in a period of rainy years, brought on, fundamentally, by this last increase in solar activity. In the accompanying graph we have prolonged the curves of solar radiation and rainfall, according to their probable course, up to the year 1930. As is seen, the rainfall will diminish a little in 1927 or 1928, increase again in 1928 or 1929, and then diminish in 1930, in which year there will begin, perhaps, a period of relative dryness. ■



These conclusions, however, are altogether provisional since it will be necessary to determine the mean of solar radiation in 1927 in order to estimate the increase that has recently begun and to (appraise) its consequences relative to the rainfall in the southern region of Chile. (However, it may be said that) the results obtained thus far are of sufficient value to afford us each year an indication (index) of the probabilities of the next winter—*Transl. W. W. Reed.*

METEOROLOGICAL SUMMARY FOR BRAZIL, MAY, 1927

By J. DE SAMPAIO FERRAZ, Director

[Directoria de Meterologia, Rio de Janeiro]

The secondary circulation in this month over the meridional and central parts of South America was particularly abnormal owing to a marked activity of depressions which reduced the usual frequency of HIGHS.

The first anticyclone of the month was already full fledged and in march to the northeast when low pressures set in, dividing the high in two sections. This area of low pressure developed a fairly deep secondary along the coast, producing high winds especially in the River Plate and Southern Brazil.

The second HIGH, which was really a return of the western section of the previous anticyclone, brought the first frosts of the season between the 12th and 14th. About this period a high-latitude depression passed by causing fresh winds in the River Plate and southern Brazil. A new HIGH dominated the continent up to the 19th. From this date till the 26th, low pressures set in again with high winds in southern Brazil and in Argentina. On the 27th was registered the advancement of the last anticyclone of the month with accentuated decline of temperature.

In a general way, rainfall was decidedly below normal throughout the country. In the south precipitation followed low pressures and contact between these and high pressures, but much less than was expected.

Rio de Janeiro had a normal month except rainfall which was below the usual value. On the 13th a stiff southwest wind was felt at night.

Crops generally doing well and better than could be expected with the marked deficiency of rainfall everywhere.

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C. FITZHUGH TALMAN, in Charge of Library

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING JUNE, 1927

By IRVING F. HAND

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1924, **52**: 42, January, 1925, **53**: 29, and July, 1925, **53**: 318.

From Table 1 it is seen that solar radiation intensities averaged above the June normals at all three stations, particularly at Washington. At this station a measured intensity of 1.47 gr. cal. per cm.^{2} obtained at noon on the 27th exceeds the previous noon intensity for June by about 3 per cent.

Table 2 shows that the total solar and sky radiation received on a horizontal surface at both Madison and Lincoln averaged above normal, while that received at Washington was close to normal.

Skylight polarization measurements made at Madison on 11 days give a mean of 60 per cent, with a maximum of 65 per cent on the 7th. These are close to normal values for June at Madison. At Washington, measurements made on four days give a mean of 57 per cent, with a maximum of 59 per cent on the 27th. These are slightly above the corresponding averages for June at Washington.

TABLE 1.—*Solar radiation intensities during June, 1927*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M. 5.0	4.0	3.0	2.0	[1] 1.0	P. M. 2.0	3.0	4.0	5.0	Local mean solar time
	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
June 1	7.57		0.71	0.85	1.00						7.57
6	7.04		0.99	1.13	1.28	1.46					8.18
8	10.59				0.74						12.24
13	8.18				1.12	1.36					11.38
16	6.27		0.91	1.02	1.18	1.38					8.18
21	13.61				0.88						15.65
27	7.57	0.87	0.98	1.11	1.24	1.48					9.14
28	11.38				0.98						13.61
29	13.61	0.64	0.78	0.87	1.00	1.32					14.60
Means		(0.76)	0.87	1.00	1.05	1.40					
Departures		+0.20	+0.22	+0.27	+0.14	+0.18					

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during June, 1927*—Contd.

Madison, Wis.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M. 5.0	4.0	3.0	2.0	[1] 1.0	P. M. 2.0	3.0	4.0	5.0	Local mean solar time
	e.	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e.
June 3	8.18					1.12					9.47
7	9.14				1.01						9.14
11	8.48				1.13						8.48
14	5.56					1.39					6.76
15	5.56				1.16						5.56
22	11.38				1.15						11.81
23	8.18					1.43					10.59
24	6.50				1.18	1.40					13.13
27	7.29				1.16	1.33					8.48
28	9.14				1.16	1.34	1.15				14.60
29	13.61		0.87	1.00	1.14	1.28					17.37
30	17.37				1.05	1.26					17.37
Means			(0.87)	(1.00)	1.13	1.32	(1.15)				
Departures			+0.01	+0.03	+0.03	±0.00	+0.08				

Lincoln, Nebr.

June 4	10.59		0.88	0.98	1.17	1.36					9.47
7	9.47			1.04	1.22	1.45					8.18
9	11.81				1.02	1.26					12.24
10	8.48				1.25	1.45					6.27
21	10.97			0.94	1.11	1.45	1.18				9.14
23	10.21			0.97	1.16	1.43	1.15	0.98	0.84		9.83
24	13.13					1.22	0.99	0.80	0.65		14.10
25	13.13			0.92	1.12	1.43	1.21	1.05	0.89		9.47
27	14.10			0.93	1.14	1.34	1.09	0.90	0.74		17.37
28	18.59			0.98	1.16	1.43	1.14	0.98			18.59
29	15.65			0.85	1.08	1.29					14.10
Means			(0.88)	0.95	1.14	1.37	1.13	0.94	0.78		
Departures			+0.11	+0.02	+0.04	+0.01	+0.03	+0.04	+0.01		

[1] Extrapolated.

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning	Average daily radiation: Washington	Madison	Lincoln	Chicago	New York	Twin Falls	Average daily departure from normal: Washington	Madison	Lincoln
1927	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
June 4	437	617	632	515	446	627	−48	+97	+57
11	501	472	310	417	450	726	+7	−30	−200
18	410	515	627	436	388	758	−68	−13	+64
25	607	651	715	566	427	747	+94	+106	+98
Deficiency since first of year on July 1							−7,707	−4,928	−5,857

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. Edwin T. Pollock, Superintendent U. S. Naval Observatory]

[Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, and Mount Wilson observatories]

Date	Eastern standard civil time	Heliographic		Area [1]	
		Longitude	Latitude	Spot	Group
1927	h. m.	°	°		
June 1 (Naval Observatory)	11 47	−87.0	+17.0		463
		+18.0	−20.0		139
		+39.5	−19.0	93	
		+62.0	−11.0		46
June 2 (Naval Observatory)	11 47	−72.0	+17.0		617
		+30.5	−19.5	123	
		+52.0	−19.0	62	
June 3 (Harvard)	10 29	−60.0	+17.0		1125
		+41.0	−19.0	137	
June 5 (Naval Observatory)	11 44	−32.0	+17.5		648
		+70.0	−19.5		93
June 6 (Naval Observatory)	11 57	−41.0	+14.5		62
		−38.5	+20.5	25	
		−19.5	+17.0		679
June 7 (Harvard)	10 24	−29.0	+15.0		197
		−9.0	+16.0		956
June 8 (Naval Observatory)	11 50	−44.5	+11.5	9	
		−14.0	+16.0		93
		+6.0	+17.0		772
June 9 (Naval Observatory)	11 46	+1.0	+15.5		62
		+19.0	+17.0		833
		+25.0	−19.5		77
June 10 (Naval Observatory)	13 55	−39.5	+21.5	9	
		−38.0	−19.0	6	
		+17.5	+16.0		40
		+32.5	+17.5		741
		+39.5	−19.0		123
June 11 (Naval Observatory)	11 32	−75.0	−9.0	77	
		−14.5	−20.5	6	
		+29.0	+15.0	31	
		+45.0	+17.0		586
		+51.5	−19.5		62
June 12 (Naval Observatory)	11 33	−62.0	−9.0	108	
		−46.0	−25.5	15	
		0.0	−20.0	6	
		+42.0	+15.0	15	
		+59.0	+17.0		494
		+66.0	−19.0	19	
June 13 (Naval Observatory)	11 46	−57.5	−25.0	9	
		−48.0	−9.0	77	
		−35.0	−26.0		37
		+14.5	−19.5	12	
		+73.0	+17.0		401
June 15 (Naval Observatory)	12 16	−30.5	−25.0	9	
		−20.5	−9.0	62	
		−5.0	−25.5	9	
June 16 (Naval Observatory)	11 49	−85.0	−10.0	31	
		−18.0	−25.0	15	
		−7.5	−9.0	77	
		+8.5	−25.5	9	
		+50.0	+20.5	12	
June 17 (Naval Observatory)	12 5	−65.0	−11.0		31
		−4.0	−25.0	19	
		+7.0	−9.0	77	
June 18 (Naval Observatory)	11 33	−50.5	−10.5	15	
		+9.0	−25.0	25	
		+20.0	−9.0	77	
June 20 (Naval Observatory)	12 24	−61.5	−9.0		93
		−23.0	−10.0		15
		−20.0	−13.0		15
		+46.5	−9.0	77	

[1] Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere.

Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic		Area	
		Longitude	Latitude	Spot	Group
1927	h. m.	°	°		
June 21 (Naval Observatory)	11 44	−47.5	−9.0		216
		−8.5	−10.5		37
		+59.5	−9.0	77	
June 22 (Naval Observatory)	11 39	−34.0	−8.5		216
		+5.0	−10.5		31
		+14.0	−5.5	9	
		+71.5	−9.0	108	
June 23 (Naval Observatory)	13 14	−60.0	−14.0	31	
		−19.0	−9.0		185
		+19.0	−11.0		93
		+31.0	−28.0		46
June 24 (Naval Observatory)	11 41	−49.0	−11.5		19
		−8.5	−9.0		185
		+32.5	−11.0		93
		+42.5	−29.0		46
June 25 (Naval Observatory)	11 42	−73.0	−19.5		123
		−72.0	−9.0		247
		−18.5	−7.5		31
		−1.0	−9.5		123
		+10.0	−9.5	22	
		+49.0	−11.0		123
		+51.5	−29.5		46
June 26 (Naval Observatory)	11 53	−75.5	−9.5	62	
		−69.0	−10.0	31	
		−59.5	−19.5	93	
		−59.0	−8.5		247
		−20.5	+21.0		46
		+5.0	+21.0		37
		+17.5	−9.0		62
		+61.5	−11.0		46
June 27 (Naval Observatory)	11 46	−64.0	−8.5	46	
		−45.5	−19.0	77	
		−44.5	−8.0		247
		−7.0	+22.0		62
		+1.0	+9.0		46
		+18.5	+22.0		139
		+29.5	−9.0		62
		+72.0	−12.0	31	
June 28 (Naval Observatory)	11 46	−69.0	−21.0		154
		−31.5	−19.0		31
		−31.0	−8.0		247
		+7.5	+22.0		62
		+14.0	+8.5		46
		+32.0	+22.0		123
		+40.5	−9.0		62
June 29 (Naval Observatory)	11 46	−73.5	+16.0		247
		−57.0	−21.0		123
		−19.0	−19.0		46
		−18.0	−8.0		247
		+21.0	+22.0		46
		+28.5	+8.0		15
		+45.0	+22.0		154
		+59.5	−9.5		62
June 30 (Naval Observatory)	11 47	−73.0	+15.0	93	
		−61.0	+16.5		340
		−43.0	−20.5		31
		−6.0	−19.0	15	
		−4.5	−8.0		370
		+0.5	−20.0		15
		+34.0	+22.0		77
		+61.0	+20.5	93	
		+68.5	−11.0	46	

AEROLOGICAL OBSERVATIONS

By WELBY R. STEVENS

Free-air temperatures for the month averaged mostly below normal, with the negative departures decreasing with altitude.

Relative humidities averaged slightly above normal; vapor-pressure departures were unimportant.

Resultant winds were about normal, although there was a tendency toward a more northerly component at most stations.

On the last four days of the month, when a HIGH of moderate intensity was moving from the Lake Region and slowly settling down over the Southern States, deep easterly winds were observed in the South Atlantic and Gulf States, as shown in the following table.

Stations	27		28		29		30	
	Height (km.)	Velocity (m. p. s.)	Height (km.)	Velocity (m. p. s.)	Height (km.)	Velocity (m. p. s.)	Height (km.)	Velocity (m. p. s.)
Atlanta					5	ESE. 8	5	ESE. 6.
Broken Arrow	11	NE. 10	7	SE. 11				
Due West			5	NE. 11	12	ESE. 18	13	E. 13.
Groesbeck	7	ENE. 17	4.5	E. 13				
Jacksonville					5	ENE. 10	11	ENE. 7
Memphis	7	ENE. 12	5	ESE. 10				
New Orleans			7	ESE. 8			9	E. 1.

Kite ascents were made at Broken Arrow and Groesbeck on the 1st during a period of thunderstorm activity in Oklahoma, Arkansas, Kansas, and western Missouri. On the morning of this date an area of high pressure covered the upper Lake Region and the northern Plains States; pressure was low over the southwest (El Paso, 29.74 inches). A well-defined discontinuity between polar and equatorial air extended from western Virginia southwestward to northern Mississippi, westward to the Texas Panhandle, thence southwestward to southern New Mexico. The aerological chart shows that a southerly current of high humidity, which had been accelerated northward under the influence of the southwest LOW, was flowing up over the layer of cold surface air. The kite flight at Broken Arrow shows a lapse rate of only 0.04 per 100 meters from surface to 1,000 meters. However, above 1,000 meters there was a southwest current of high relative humidity and high lapse rate (0.59, adiabatic for saturated air) extending to at least 2,300 meters. Since the humidity was high, only a small upgrade movement was necessary to start condensation. Once condensation begins ascent will be spontaneous as long as there is any water vapor left. The upgrade movement was produced by ascent over the relatively cold surface layer. The flight at Groesbeck on this date showed much the same conditions as at Broken Arrow, except for the fact that Groesbeck was in the warm sector; consequently there was no surface layer of cold air to produce an upgrade movement, condensation, and spontaneous convection. This is a type of warm front rain which plays an important rôle in the weather of the Southern States and has been studied and described in considerable detail by Rossby and Weightman.[1]

A flight was made at Groesbeck on the 13th just a few hours in advance of the arrival of a cold front. Severe thunderstorms occurred in the vicinity and 2.05 inches of rain fell at the station. Between the ascent and descent of the kites we find that a layer of south-southeast wind which had extended to an altitude of 750 meters had been replaced by a south current. Temperature increased to an altitude of 750 meters and fell above this height. The greatest fall, 3.3° C., occurred at an altitude of 1,500 meters. The cold current arriving with a southerly wind was due to adiabatic cooling as a result of forced ascent which takes place in advance of the cold wedge.

The highest kite flight of the month (5,897 meters) was made at Royal Center on the afternoon of the 24th, southeast of the center of a deep LOW. This flight is of particular interest on account of the unusually low humidity (11 to 50 per cent) observed at all levels, and on account of the small amount of precipitation attending the advancing LOW. The weather and aerological charts for this date show a strong current of southerly air in front of the LOW. Ordinarily this air would be moist. However, we find that the surface southerly current was not Gulf air but returning polar air, while the winds aloft had come from the arid regions of the southwest. Under conditions of this kind general rains can not be expected until the LOW has advanced far enough to obtain moist air from the Atlantic.

[1] Carl-Gustaf Rossby and Richard Hanson Weightman: Application of the Polar Front Theory to a Series of American Weather Maps. MO. WEATHER REV. Dec., 1926, 54: 485.

TABLE 2.—*Free-air resultant winds (m. p. s.) during June, 1927*

Altitude, m.s.l. (meters)	Broken Arrow, Okla. (233 meters)				Due West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)				Washington, D. C. (34 meters)			
	Mean		9-year mean		Mean		7-year mean		Mean		10-year mean		Mean		9-year mean		Mean		9-year mean		Mean		7-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 6°W.	4.0	S. 6°W.	4.1	N. 64°E.	1.1	S. 78°W.	1.0	N. 52°W.	1.2	N. 56°W.	0.4	S. 3°W.	3.6	S. 2° E.	3.4	S. 7°W.	1.6	S. 55°W.	1.6	N. 53°W.	0.5	N. 43°W.	0.7
250	S. 5°W.	4.1	S. 6°W.	4.2	N. 64°E.	1.1	S. 74°W.	1.1					S. 3°W.	4.0	S. 1°E.	4.0	S. 14°W.	1.9	S. 50°W.	1.7	N. 68°W.	1.6	N. 59°W.	1.8
500	S. 13°W.	5.8	S. 10°W.	5.6	N. 59°E.	0.9	S. 80°W.	1.7	N. 83°W.	1.2	N. 71°W.	0.3	S. 6°W.	4.9	S. 3°W.	5.4	S. 25°W.	2.9	S. 52°W.	2.9	N. 50°W.	2.6	N. 53°W.	2.9
750	S. 21°W.	6.3	S. 15°W.	6.1	N. 50°E.	1.2	S. 77°W.	2.3	S. 88°W.	1.9	S. 45°W.	0.9	S. 10°W.	6.0	S. 6°W.	5.8	S. 45°W.	3.3	S. 59°W.	3.9	N. 50°W.	3.8	N. 52°W.	3.5
1,000	S. 28°W.	6.0	S. 24°W.	6.4	S. 19°W.	0.9	S. 76°W.	2.5	N. 70°W.	1.6	S. 48°W.	1.2	S. 14°W.	6.6	S. 10°W.	6.2	S. 55°W.	3.3	S. 70°W.	4.6	N. 35°W.	5.2	N. 46°W.	4.3
1,250	S. 30°W.	6.0	S. 27°W.	6.3	S. 51°W.	3.0	S. 78°W.	3.4	N. 78°W.	2.1	S. 65°W.	1.9	S. 18°W.	6.9	S. 11°W.	6.4	S. 53°W.	2.9	S. 75°W.	5.1				
1,500	S. 42°W.	6.1	S. 33°W.	6.3	S. 58°W.	5.2	S. 80°W.	4.5	N. 73°W.	2.4	S. 70°W.	2.4	S. 16°W.	7.2	S. 12°W.	6.0	S. 63°W.	2.9	S. 84°W.	5.1	N. 46°W.	7.4	N. 54°W.	6.0
2,000	S. 36°W.	5.4	S. 37°W.	6.4	S. 74°W.	8.6	S. 84°W.	6.5	N. 68°W.	3.5	S. 78°W.	3.5	S. 20°W.	7.1	S. 13°W.	5.6	S. 69°W.	4.2	S. 86°W.	7.4	N. 63°W.	7.9	N. 65°W.	7.1
2,500	S. 45°W.	5.5	S. 40°W.	6.5	S. 73°W.	11.0	S. 82°W.	7.2	N. 70°W.	4.5	S. 82°W.	5.3	S. 14°W.	5.8	S. 12°W.	5.2	S. 74°W.	7.3	S. 83°W.	9.3	N. 68°W.	8.5	N. 67°W.	5.8
3,000	S. 53°W.	7.0	S. 43°W.	6.6	S. 85°W.	11.4	S. 86°W.	8.9	N. 58°W.	6.3	S. 88°W.	7.3	S. 14°W.	3.8	S. 15°W.	5.3	S. 82°W.	9.4	S. 89°W.	10.6	N. 72°W.	9.8	N. 80°W.	8.7
3,500	S. 35°W.	8.3	S. 47°W.	7.1	S. 82°W.	12.8	S. 84°W.	10.2	N. 66°W.	8.9	S. 89°W.	9.3	S. 9°W.	6.6	S. 7°W.	5.7	S. 85°W.	11.0	S. 88°W.	10.8				
4,000	S. 46°W.	11.1	S. 60°W.	7.9	S. 67°W.	16.0	S. 82°W.	10.0	N. 69°W.	14.0	N. 87°W.	11.8	S. 1°W.	9.7	S. 7°W.	6.6	S. 86°W.	10.6	N. 85°W.	12.2				
4,500									N. 45°W.	16.0	N. 80°W.	13.4	S.	10.0	S. 10°W.	8.5	N. 45°W.	16.1	N. 67°W.	11.0				
5,000																	N. 45°W.	14.1	N. 42°W.	17.6				

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during June, 1927*

TEMPERATURE (° C.)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		*Washington, D. C. (7 meters)
	Mean	Departure from 9-year mean	Mean	Departure from 7-year mean	Mean	Departure from 10-year mean	Mean	Departure from 9-year mean	Mean	Departure from 9-year mean	Mean
Surface	23.5	−1.5	23.5	−2.8	16.8	−2.1	25.6	−0.5	19.0	−3.4	24.2
250	23.4	−1.5	23.2	−2.7			24.7	−0.4	18.7	−3.4	22.6
500	22.0	−1.0	20.7	−2.5	16.4	−2.1	22.6	−0.5	16.3	−3.1	19.9
750	20.7	−0.8	19.2	−2.2	15.0	−1.9	21.2	−0.4	15.0	−2.5	18.2
1,000	19.6	−0.6	18.2	−1.7	14.1	−1.4	20.2	−0.2	13.7	−2.2	16.7
1,250	18.5	−0.4	17.3	−0.9	13.0	−1.2	19.1	−0.1	12.5	−1.9	15.1
1,500	17.2	−0.3	16.1	−0.4	12.0	−0.9	18.0	0.0	11.5	−1.5	13.5
2,000	15.0	+0.3	13.0	−0.1	9.1	−1.0	15.2	−0.5	9.3	−1.1	10.8
2,500	12.2	+0.3	9.9	0.0	6.3	−1.0	12.8	−0.3	6.5	−1.1	8.5
3,000	10.0	+1.1	7.2	+0.4	3.9	−0.6	9.9	−0.6	3.8	−1.0	6.5
3,500	6.4	+0.7	3.6	+0.1	1.1	−0.5	6.5	−1.2	1.2	−0.9	
4,000	3.4	+0.8	0.2	−0.5	−1.6	−0.4	3.1	−1.9	−1.4	−1.0	
4,500					−4.2	+0.1	0.1	−1.9	−5.4	−2.1	
5,000									−9.2	−2.1	

RELATIVE HUMIDITY (%)

Surface	77	+5	70	+8	75	+5	80	+6	70	+6	62
250	77	+5	70	+8			82	+7	70	+6	65
500	73	+1	73	+8	75	+6	86	+9	73	+8	66
750	72	0	72	+6	73	+6	86	+10	72	+6	62
1,000	70	−1	73	+6	69	+3	79	+7	70	+4	62
1,250	68	−1	75	+7	68	+3	74	+6	68	+2	60
1,500	66	−1	77	+8	65	+2	70	+6	63	−1	56
2,000	57	−5	78	+8	64	+3	65	+9	57	−3	57
2,500	53	−3	75	+6	69	+10	54	+2	54	+1	44
3,000	47	−5	70	+4	61	+6	52	+3	51	+2	40
3,500	53	+1	62	−2	58	+7	54	+7	44	+2	
4,000	62	+10	68	+10	55	+8	62	+15	40	+6	
4,500					45	0	70	+19	45	+11	
5,000									55	+11	

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during June, 1927*—Continued

VAPOR PRESSURE (*mb.*)

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		*Washington, D. C. (7 meters)
	Mean	Departure from 9-year mean	Mean	Departure from 7-year mean	Mean	Departure from 10-year mean	Mean	Departure from 9-year mean	Mean	Departure from 9-year mean	Mean
Surface	22.04	−0.57	20.12	−0.72	14.79	−0.71	25.98	+1.39	15.74	−1.88	19.33
250	21.79	−0.61	19.81	−0.70			25.33	+1.60	15.57	−1.77	17.68
500	19.06	−0.96	18.07	−0.28	14.33	−0.69	23.35	+1.64	13.96	−1.14	15.75
750	17.15	−0.91	16.21	−0.54	12.71	−0.47	21.45	+1.77	12.74	−1.03	13.43
1,000	15.42	−0.98	15.38	−0.13	11.23	−0.64	18.44	+1.24	11.32	−1.32	12.33
1,250	13.95	−0.73	14.80	+0.46	10.14	−0.57	15.97	+0.91	10.15	−1.43	10.86
1,500	12.52	−0.53	13.93	+0.77	8.96	−0.56	13.95	+0.84	8.63	−1.71	9.33
2,000	9.24	−0.73	11.68	+0.92	7.41	−0.31	10.64	+0.69	6.33	−1.61	7.79
2,500	7.23	−0.12	9.14	+0.66	6.61	+0.25	7.25	−0.60	5.04	−0.58	4.82
3,000	5.71	+0.16	7.09	+0.47	5.05	+0.14	5.49	−0.80	3.96	−0.19	3.90
3,500	5.23	+0.79	5.00	−0.09	4.21	+0.30	4.42	−0.73	2.82	+0.07	
4,000	5.06	+1.44	4.27	+0.53	3.68	+0.49	3.84	−0.51	2.23	+0.53	
4,500					2.88	+0.37	3.21	−0.65	1.90	+0.62	
5,000									1.81	+0.62	

* Naval air station.

WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

The weather of the current June was similar to that of June, 1926, to the extent that both were cool east of the Rocky Mountains. The explanation of the cool weather may be found in the distribution and movement of HIGHS and LOWS. To what extent this is conditioned upon world-wide pressure distribution is not at present apparent. Atmospheric pressure was unusually low over the northeast Pacific; it was also low over western Europe, except Spain and Italy, and high from Spitzbergen and Iceland to the Azores. In the United States it was high east of the Rocky Mountains and there was a decided increase from the previous month as may be seen from the insets on Charts I and II of this REVIEW.—*A. J. H.*

CYCLONES AND ANTICYCLONES

Six HIGHS and 13 LOWS were plotted during June. This is the least number for any month so far this year. A minimum number would be expected during June or July, since the temperature contrast between Pole and Equator is likewise at a minimum, with a corresponding reduction of air interchange.

Low No. XI showed an unusual movement. It was first noted on June 28 as the pinched-off lower end of a trough in the Atlantic near latitude 40° N., longitude 55° W; and with high pressure building up to the north and east, it was forced southwestward to Bermuda on the evening of the 30th. From Bermuda it moved slowly northwest to the New England coast during the first few days of July.—*W. P. Day.*

THE WEATHER ELEMENTS

By P. C. DAY

PRESSURE AND WINDS

The distribution of pressure during the month favored continued cool weather over nearly all central and northern districts from the Rocky Mountains eastward, where the preceding month had likewise been cool, and general coolness extended into most southern districts also, where in some sections monthly temperatures had been continuously above normal since January. It also favored frequent precipitation over many southern districts where the State averages were mainly in excess of the normal.

June opened with general low pressure over the Southwest, and by the morning of the 3d a well-defined cyclone was central over the eastern portions of Kansas and Oklahoma, and considerable precipitation had occurred over the central valleys, and from the middle Mississippi Valley eastward to the Atlantic coast where secondary lows had developed. By the morning of the 4th the main storm center had advanced to the lower Lakes and important rains had fallen from the lower Missouri Valley eastward to the Appalachian Mountains, continuing during the following 24 hours to New England and the lower St. Lawrence Valley.

Rain again set in on the 5th and 6th over the southern Plains and local thundershowers prevailed over the Southeast for several days following. At the same time a moderate cyclone passed along the northern border from western Montana to New England, attended by rather general but mostly light precipitation.

About the 12th rains overspread the middle Plains, extending eastward into the middle Mississippi and lower Ohio Valleys, with heavy falls in portions of Iowa and Illinois. By the morning of the 13th showery conditions had extended into the Southeastern States and local heavy rains continued in portions of the middle Mississippi Valley and near-by areas. Rains continued over much of the same territory during the 14th and 15th, with heavy falls in portions of Texas and locally in the States to the eastward and northeastward.

On the morning of the 17th a moderate cyclone was central over eastern Kansas, and heavy precipitation had occurred within the preceding 24 hours in portions of east Texas and locally at a few points in the Gulf States. During the following two days this depression moved to the Atlantic coast, but with generally diminishing energy. Immediately following this depression thunderstorms overspread a large area from the northern Plains southeastward to Florida, and by the morning of the 21st showers had occurred in the central valleys from the Gulf of Mexico to Canada, with heavy falls locally in the Mississippi Valley region. During the following 48 hours this rain area moved northeast of the Great Lakes, but more or less rain occurred in connection with it over most eastern districts.

The last week of the month was without important cyclonic development and local showers were confined to small areas.

Anticyclonic conditions were most pronounced over the central Eastern States, where the average sea-level pressure was the highest save over a small area along the north Pacific coast.

Storms of various kinds were distributed in the usual way during the month, but were confined for the first few days chiefly to the middle and southern Plains States. Later in the month they were less frequent and not restricted so generally to a particular area. Tornadoes were infrequent and generally unimportant, with little or no attending loss of life. Hailstorms, on the other hand, were frequent, occurred over wide areas and in all portions of the month, and caused heavy damage, chiefly to crops.

The usual details of the more severe storms of the month appear in the table at the end of this section.

TEMPERATURE

The most notable feature of the temperature distribution was the persistence of cool weather over most districts from the Rocky Mountains eastward. This resulted mostly from low day temperatures, as was the case in the preceding month over the northern half of the country, and persisting so constantly, week after week, gave promise until near the close of being the coldest June of record over a large number of the Central and Northern States from the Rocky Mountains to the Great Lakes and Ohio Valley. An unusually warm wave during the last few days prevented this, however, but the month will stand as near the coldest of record in much of the territory referred to above, and in the case of one station at least, Louisville, Ky., it was the actual coldest June in more than half a century.

The month as a whole had few important variations in temperature. In fact on only two occasions were the 24-hour changes, 8 a. m. to 8 a. m., equal to 20°, and these occurred only over limited areas.

The first week continued warmer than normal over the southern districts from New Mexico eastward, where temperatures had generally been above normal for a considerable period, and the week was moderately warm in the far Northwest also. Over the northern and central districts from the Rocky Mountains eastward this week continued distinctly subnormal, as was the case during much of the preceding month. The second week, though moderately warm for the first few days, continued cool as a whole over much of the same area, and coolness penetrated into much of the South, while in the far Northwest the week continued moderately warm.

The third week continued cool in the main over the eastern two-thirds of the country, particularly in the central valleys and most eastern districts, the departures ranging from −6° to −9° per day, except along the immediate Gulf coast and over the Florida peninsula, where temperature averages were normal or slightly higher. In the far West the week continued moderately warm.

The week covering the period, June 21 to 28, continued cool generally over the eastern half of the country, and small areas over the far West had average temperatures slightly lower than normal, though in most Plateau and Rocky Mountain regions this week was moderately warm. The last three days of June had a sharp reversal of temperature over most districts from the Great Plains eastward and a warm wave of considerable strength prevailed at the close.

Despite the general coolness of June from the Rocky Mountains eastward, there were occasional periods with maximum temperatures above 100° over the greater part of this area at some time during the month. From the 1st to 5th local readings of 100° or slightly higher were reported from the Gulf States; about the 9th and 10th the highest temperatures of the month, slightly less than 100°, occurred over the Northeastern States; from the 21st to 26th the highest temperatures, generally above 100°, were reported in the districts from the Rocky Mountains westward, while the last three days were the warmest from the Dakotas eastward and southeastward to the Great Lakes and Ohio Valley, when maximum temperatures were usually slightly above 100°.

Although a cold month over much of the country the temperatures were in no case as low as had been previously observed in June, and only over the more northern districts and in the high mountains were they injuriously low.

The departures of the mean temperature for the month from the normal are graphically shown on Chart III of this issue.

PRECIPITATION

Over all Southern States from the Atlantic to the Pacific, except in southern Florida, the precipitation for June was well distributed and generous, being mainly above normal, Arkansas having nearly two and a half inches in excess. There was also a general excess in the southern part of the central section from Utah to Kentucky and Tennessee, with some State averages materially in excess of the normal, and locally, particularly in Colorado and Kansas, there were unusually frequent and heavy falls during the first three weeks. In portions of Florida one of the worst droughts of record was mainly terminated, though in the southern portions it was only partly relieved and large monthly deficiencies still existed at the end.

In practically all the northern tier of States June precipitation was deficient, but usually not to a serious extent. In the tier from South Dakota and Nebraska eastward there were extensive deficiencies, particularly in Iowa,

where locally in the central portion it was the driest June of record. Deficiencies were large in portions of the Lake region also, and locally in near-by areas. In the far West precipitation was light as usual, though locally in southern Washington, northern Oregon, and near-by portions of Idaho there were some heavy falls.

SNOWFALL

Traces of snow were reported at a few northern points and locally as far south as Kansas. In western Montana and northern Wyoming measurable amounts fell at a few exposed points. In the high Sierra of California there were local falls ranging up to 20 inches. Elsewhere in the mountain districts the falls were usually no more than traces.

RELATIVE HUMIDITY

Despite the general low temperatures, the percentages of relative humidity were distinctly less than normal in the Great Lakes region and to a less extent to the westward as far as the Dakotas, also over the Atlantic Coast States from Virginia to New England.

In other portions of the country the percentages were mainly above normal, and distinctly so in the Rocky Mountain region and over most of the Southeastern States except Florida, where the percentages were generally less than normal.

SEVERE LOCAL STORMS, JUNE, 1927

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annua Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Westville, Okla., and vicinity.	1	2 p. m.	4 mi.		$360,000	Heavy hail	Damage chiefly to crops; property damage considerable.	Official, U. S. Weather Bureau.
White City, Kans.	1	2:45-3 p. m.	3,520			do	Wheat flattened; roofs pierced; poultry and small animals killed; path 16 miles long.	Do.
Ashland County, Wis.	1	4 p. m.				do	Considerable minor damage reported.	Do.
Payne County, Okla. (south central).	1	4:30 and 6 p. m.	3 mi.		28,000	Two hailstorms	Crop losses heavy; minor property damage; path about 8 miles.	Do.
Stroud, Okla., and vicinity.	1	5 p. m.	1,760		200,000	Wind, hail, and rain.	A number of houses demolished, many damaged; heavy losses in oil fields; plate-glass windows broken; trees torn; 3 persons injured.	Do.
Avery and Kendrick, Okla. (vicinity of).	1	5-5:30 p. m.	10 mi.			Heavy hail	Severe crop injury; other minor damage.	Times Record (Fort Smith, Ark.).
Between Knox City and Munday, Tex.	1	5-8 p. m.	6 mi.		220,000	do	Thousands of acres of crops ruined, necessitating replanting; buildings damaged.	Official, U. S. Weather Bureau.
Limon, Colo.	1	6 p. m.	15 mi.		350,000	do	All damage reported was to crops.	Do.
Tillman County, Okla. (western).	1	7-8 p. m.	4 mi.		122,000	do	Extensive crop damage over path 10 miles long.	Do.
Grady County, Okla. (northern).	1	8 p. m.	3 mi.		84,500	do	Severe crop loss; minor damage to property; path 15 miles long.	Do.
Norman, Okla., and vicinity.	1	9 p. m.	5 mi.		20,000	do	Damage principally to crops over path 10 miles long.	Do.
Ketchings Mills and Monetta, S. C.	1	P. m.			1,000	Hail	Crops injured.	Do.
Hamilton, Kearny, and Finney Counties, Kans.	2	12.30 a. m.	3 mi.		60,000	Heavy hail	Wheat and barley damaged over path 60 miles long.	Do.
Barton, Pawnee, and Stafford Counties, Kans.	2	1-3 a. m.	30 mi.		2,000,000	do	Thousands of acres of wheat destroyed; minor damage to buildings.	Do.
Ross County, Ohio (eastern).	2	1-3 a. m.			15,000	do	Storm very destructive to crops and gardens.	Do.
Dodge City, Kans.	2	1.40 a. m.	400		200,000	Violent wind	25 buildings unroofed, 50 others damaged.	Do.
Ford County, Kans.	2	2 a. m.	7 mi.			Heavy hail	Chief damage to wheat.	Do.
Miles to Venita, Okla.	2	7 a. m.	4 mi.		100,000	do	Heavy crop and property damage over path 14 miles long.	Do.
Tecumseh, Okla. (near)	2	2 p. m.				do	Character of damage not reported.	Do.
Denver, Colo.	2	5:26 p. m.	5-7 mi.		500,000	do	Severe damage to greenhouses, skylights, and truck gardens; 4 persons injured.	Do.
Branchville, S. C. (near)	2	5:30 p. m.		2		Thunderstorm	4 persons injured.	Do.
Cheyenne County, Kans.	2	7 p. m.	3,520			Heavy hail	Wheat badly damaged.	Do.
Rockport, Ind., and vicinity.	2	8-9 p. m.				Wind	Heavy crop loss; some damage to windows, roofs, and trees.	Evansville Journal (Ind.).
Dundy County, Nebr.	2	9:30 p. m.	3 mi.			Heavy hail	Considerable damage to crops, gardens, and roofs.	Official, U. S. Weather Bureau.
Washita County, Okla. (southern).	2	9-10 p. m.	3 mi.		100,000	do	Severe damage to crops; poultry, rabbits and small livestock killed.	Do.
Holt County, Nebr. (eastern).	2	11 p. m.	3,520			do	Rye, alfalfa, and gardens injured over path 50 miles long.	Do.
Canadian County, Okla. (southeastern).	2		3 mi.			do	Crops a total loss in center of storm; other minor property damage.	Do.
Gotebo, Okla. (north of)	2	P. m.	¼-10 mi.			do	Severe damage, estimate not obtainable.	Do.
Seminole, Okla. (near)	2				5,000	do	Some damage in oil fields.	Do.
Cheyenne, Rawlins and Decatur Counties, Kans.	2-3	10:30 p. m. 1 a. m.	4-20 mi.		500,000	do	Damage chiefly to wheat and barley over path 100 miles long.	Do.
Rooks and Osborne Counties, Kans.	3	4-5 a. m.	1-10 mi.		200,000	do	About 57 square miles devastated.	Do.
Boone and Callaway Counties, Mo.	3	5-6 a. m.		2		Thunderstorm and wind.	Damage confined to trees, outhouses, telephone and telegraph wires.	Do.
Cloud County, Kans.	3	5-6 a. m.	3 mi.		240,000	do	Extensive crop damage over large area.	Do.
Hannibal, Mo., and vicinity.	3	1:22 p. m.			100,000	Wind and hail	Numerous buildings damaged; overhead wire systems impaired.	Do.
Saline County, Kans.	3	3:30-4 p. m.	3-4 mi.		50,000	Heavy hail	Wheat damaged over path 30 miles long.	Do.
Atchison and Doniphan Counties, Kans.	3	4:30 p. m.	3 mi.		25,000	do	Growing crops damaged.	Do.
Herington, Kans.	3	4:30 p. m.	3 mi.		110,000	do	10,000 acres of wheat ruined; heavy damage to buildings.	Do.
Topeka, Kans. (near)	3	4.40 p. m.	33.		400	Small tornado	Damage confined to small buildings and trees over a path 5½ miles long.	Do.
Perrytown, Tex. (near)	3	6 p. m.				Heavy hail	Storm reported very destructive to crops and buildings.	Do.
Auburn, Kans.	3	6.30 p. m.	90.		1,000	Double tornado	2 parallel paths less than 2 miles long.	Do.
Fulton, La Salle, Macoupin, Marshall, Peoria, Pike, Sangamon, Schuyler, and Tazewell Counties, Ill.	3	P. m.				Wind, rain, and hail.	Extensive damage to crops, buildings, orchards; heavy damage to basements and railroad beds by flooding.	Do.

[1] "Mi." signifies miles instead of yards.

Severe local storms, June, 1927—Continued

Place	Date	Time	Width of path, yards [1]	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Cushing, Okla. (4 miles west of).	3				350,000	Wind	Severe crop loss and property damage	Official, U. S. Weather Bureau.
Paducah, Ky., and vicinity.	3				30,000	Wind and hail	Steel work of 6-story building wrecked; numerous barns and other buildings unroofed.	Do.
Wray, Colo.	3					Heavy hail	About 50 per cent of crops destroyed	Do.
Huntington and Markle, Ind. (near).	4	1-2 a. m.			100,000	Tornadic wind	Much damage to farm properties	Do.
Grove and Lane Counties, Kans.	4	P. m.	5 mi.			Heavy hail	Fields in path left bare; trees stripped; livestock and poultry killed; hail in drifts 8 to 15 feet deep.	Do.
Peru, Ind.	4				8,000	Wind	Buildings damaged	Do.
Shields, Kans.	4	P. m.	880		50,000	Tornado and hail	Damage by hail severe; minor wind damage	Do.
San Jon, N. Mex.	5	5 p. m.	3-5 mi.		10,000	Hail	Poultry killed; homes and farm buildings considerably damaged.	Do.
Grover, Colo. (near)	5		3 mi.		10,000	do	Character of damage not reported	Do.
Mobile, Ala. (9 miles north of).	5				1,500	do	Melons and vegetables injured	Do.
Wellborn, Fla.	6	2.30 p. m.	3-6 mi.		11,000	do	Damage principally to crops	Do.
Ville Platte, La. (2 miles south of).	6	4.45 p. m.				Wind and hail	Small church blown down; corn and cotton injured.	Do.
Gainesville, Fla.	6	5.30 p. m.	3 mi.		5,000	Heavy hail	Melons and corn damaged	Do.
Kilgore, Nebr. (near)	7	Noon	2-5 mi.			do	Crops considerably damaged over path 7 miles long.	Do.
Lake City, Fla., and vicinity.	7	3-4 p. m.	12 mi.			Wind and hail	Young crops beaten; corn and tobacco damaged	Do.
Portland, Oreg.	7	6 p. m.				Wind and rain	Damage chiefly by excessive rains flooding basements, sewers and homes; traffic menaced by washing of roads.	Official, U. S. Weather Bureau. The Oregonian (Portland, Oreg.).
Scott County, Iowa	7	7 p. m.			30,000	Hail	Crops damaged	Official, U. S. Weather Bureau.
Fresno, Calif.	7					Thundersquall	Plate-glass windows broken; shade trees blown down; much fruit knocked off.	Do.
Boone, Floyd, Franklin, Greene, Hancock, Hardin, Jasper, Marshall, and Story Counties, Iowa.	8	4-7 p. m.			100,000	Hail, wind, and floods.	Severe crop injury; much damage to buildings and roads.	Do.
Polk, Sawyer, and Washburn Counties, Wis.	9	8-9 p. m.			78,000	Severe squall; probably tornado.	Silos, small farm buildings and timber damaged; 3 persons injured.	Do.
Houghton, Mich., and vicinity.	9					Electrical	Light and telephone lines damaged; tracks undermined; farm house burned.	Do.
Murray City, Ohio	10	P. m.			100,000	Cloudburst	Property of all kinds destroyed	Do.
Fort Stockton, Tex. (near)	11	4-5 p. m.	3 mi.		22,500	Hail	Crops badly hurt; roofs and windows pierced	Do.
Muscotah, Kans.	11	7:45 p. m.	880		1,000	Small tornado	Trees and outbuildings damaged	Do.
Nashville, Tenn.	11				50,000	Electrical	Warehouse and contents destroyed	Do.
Chattanooga, Tenn., and vicinity.	12	A. m.				Thunderstorm	About 500 telephones out of use; many trees and poles leveled.	Do.
Wray, Colo.	12					Heavy hail	About half of crops destroyed	Do.
Cedar Edge, Colo.	14	2 p. m.			10,000	do	Damage entirely to crops over narrow path	Do.
Chester, S. C.	14	P. m.			1,500	Thunderstorm and wind.	Some buildings damaged	Do.
Whitman County, Wash.	16					Hail	Growing crops considerably injured	Do.
Rapid City, S. Dak.	17	12-3 p. m.				Hail, wind and rain.	Windows in buildings and greenhouses broken; roofs and auto tops pierced; air mail ship badly wrecked; gardens in city ruined.	Do.
Memphis, Tenn. (near)	17	6-7 p. m.	140			Probably tornado	One barn demolished; trees and telephone lines damaged; truck gardens injured.	Do. Press Scimitar (Memphis, Tenn.).
Alliance, Nebr.	18	4 p. m.	3 mi.		50,000	Hail	Much injury to crops; roofs damaged; path 7 miles long.	Official, U. S. Weather Bureau.
Labette and Neosho Counties, Kans.	19	Midnight-4 a. m.	do		50,000	Violent wind	Small buildings, trees, telephone and telegrapn lines damaged.	Do.
Joplin, Mo.	19	A. m.			10,000	Wind and rain	Two homes wrecked and many buildings damaged; poles and trees blown down.	Do.
Wright County, Kans.	19	6-8 p. m.	5 mi.			Heavy hail	Damage chiefly to wheat, loss ranged up to 100 per cent.	Do.
Norfolk, Nebr.	20	3:30 p. m.	3		100	Tornado	Greenhouse damaged	Do.
Buffalo and Dawson Counties, Nebr.	20	4-5 p. m.	4-9 mi.			Heavy hail	Vegitation destroyed at various points over path 70 miles long.	Do.
Rooks County, Kans.	20	6-6:30 p m.	3 mi.		20,000	do	Approximately 20,000 acres of wheat damaged	Do.
Seward County, Kans.	20	6:45 p. m.	5 mi.			do	Crops in path entirely destroyed; many buildings damaged.	Do.
Sidney, Ohio (north of)	21	8 p. m.				Wind	Considerable damage to trees, buildings and overhead wires.	Do.
Chattanooga, Tenn.	21					Thunderstorm	Some damage to construction work; telephone and telegraph service impaired.	Do.
Lubbock, Tex. (vicinity of)	22	7:30-8:30 a. m.	3 mi.			Heavy hail	Severe damage to cotton; feed stuff shredded; poultry killed.	Do.
Stanley, Wis. (near)	24	10 a. m.	3,520			do	Damage severe, character not reported	Do.
Buffalo, N. Y.	25	6 p. m.				Thunderstorm	Damage by flooding and lightning; 6 persons injured.	Do.
Lackawanna and Wyoming Counties, Pa.	26					do	Several buildings partially destroyed; considerable damage by rain.	Do.
Aladdin, Wyo. (near)	27	3:30 p. m.	1,760		19,500	Wind and hail	Roofs, windows, crops and timber damaged or destroyed.	Do.
Adon, Wyo.	27	5:45 p. m.			17,500	Small tornado	Several buildings wrecked; 4 persons injured	Do.
Alliance, Nebr.	28	4 p. m.	3 mi.		250,000	Heavy hail	Wheat beaten over large area; light globes broken; windows shattered; roofs punctured.	Do.
Crown Point, N. Mex.	28	4-5 p. m.	4 mi.			Wind and hail	Roof damaged; several small buildings razed	Do.
Edna, Tex.	28		3,520		6,000	do	Crops damaged about 10 per cent; trees and windows broken; 6 oil derricks wrecked.	Do.
Valentine, Nebr.	29					Two thunderstorms.	Loose objects blown around; awnings and trees torn; other minor property damage.	Do.
Oberlin, Kans.	30	3:30 p. m.	5 mi.			Violent wind	Barns and shade trees wrecked	Do.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

On the evening of the 4th, storm warnings were ordered from New London, Conn., to Eastport, Me., in connection with a disturbance of moderate intensity north of Lake Ontario. Strong winds occurred during the night and the warnings were lowered the following morning.

With a disturbance of slight intensity over northwestern Virginia on the morning of the 14th, storm warnings were ordered from Delaware Breakwater to Nantucket and small craft warnings south of Delaware Breakwater to Hatteras. Winds were fresh to strong from Atlantic City to Hatteras, but were only fresh north of Atlantic City.

On the morning of the 20th, when a disturbance of slight intensity was central 250 to 300 miles off the Virginia coast, storm warnings were hoisted between Boston and Block Island, and small craft warnings south of Block Island to Delaware Breakwater. On the evening of that date storm warnings were also ordered at Eastport, Me. Winds occurred substantially as indicated in the advices.

On the morning of the 23d, both in the State forecasts and radio bulletins, fresh to strong winds were forecast for the middle and north Atlantic coast and occurred as forecast. Severe squalls, at the time the wind shifted from southwest to northwest, were reported between Block Island and Sandy Hook.

Small craft warnings were advised on the 3d, 7th, 10th, 14th, 19th, and 20th for portions of the Atlantic coast from North Carolina northward.

On the 1st, warnings for heavy frost were issued for portions of New York, Pennsylvania, and the interior of New England, and occurred over northern New York and the interior of middle and northern New England.

On the 5th warnings for light frost were issued for portions of New York, Pennsylvania, western Massachusetts, and western Maryland, but temperatures were not quite low enough.—*R. H. Weightman.*

CHICAGO FORECAST DISTRICT

Storm warnings.—No general, severe disturbances affected the Great Lakes during the month and the number that developed enough energy to require warnings locally was small.

On the morning of the 4th storm warnings were ordered for Lake Huron and the lower lakes; verifying velocities were recorded at Port Huron and Erie.

On the night of the 9th storm warnings were ordered for Lakes Superior, Michigan and northern Huron and later these warnings were changed to small craft. Again on the night of the 21st small-craft warnings were displayed from Duluth to Munising on Superior and on northern Michigan and later extended to the lower lakes.

On the morning of the 24th storm warnings were issued for Lake Superior and northern Michigan; later in the day they were extended over southern Michigan and northern Huron and at night over southern Huron. On the morning of the 25th the small-craft warnings of the previous day were changed to storm warnings and all were lowered at night of that day.

Frost warnings.—Frost warnings were necessary from time to time during the first half of the month, but in all cases they were confined to the States of Minnesota, Michigan, and Wisconsin. In most cases the warnings specified light frost on low ground.—*C. A. Donnel.*

NEW ORLEANS FORECAST DISTRICT

Weather disturbances were generally of the summer type, with more than normal frequency of precipitation in the eastern and southern portions of the district, but were not attended by strong winds except where thunderstorms caused strong local winds for brief periods on a few days. No storm warnings were issued or required. Small craft warnings were displayed locally on the west coast of Texas on the 14th, 24th, and 29th.

Fair weather forecasts extending beyond the usual 36-hour period were issued on the 7th, 14th, and 21st and sent to addresses in Oklahoma for the benefit of alfalfa harvesters.—*R. A. Dyke.*

DENVER FORECAST DISTRICT

No warnings issued during the month.—*E. B. Gittings.*

SAN FRANCISCO FORECAST DISTRICT

The most remarkable feature pertaining to the meteorological work in this forecast district during June was the abnormal pressure situation over the northeast Pacific Ocean. The subpermanent high-pressure system, normally centered west of San Francisco and northeast of Hawaii, was at times displaced far to the west and south and at other times wholly absent, while for a large part of the month the trade-wind system was thoroughly disorganized. This condition attracted unusual attention because of the extraordinary interest which centered on weather and winds over the flying routes from this coast to Hawaii, coincident with the plans of several aviators to attempt the voyage during June, an interest which reached its climax with the flight of the Army plane from San Francisco to the islands on June 28–29, 1927. The great hazard in this flight, ranking second to the possibility of motor failure only, was involved in the possibility of not keeping the course to the objective, since a relatively slight deviation might mean disaster. Hence it was most essential to make proper allowance for probable drift, and the amount and direction of drift could only be gaged by an accurate foreknowledge of wind direction and velocity along the route. The unstable pressure conditions at sea were naturally the cause of some concern in view of the navigational uncertainties they implied.

Evidence of a change in this state of things was indicated on the weather charts of June 22 and notice was duly given that a resumption of normal conditions might be expected soon. Within three days thereafter a pressure reaction to normal had taken place and the trade winds were functioning as usual for the season.

For several days prior to the flight regular bulletins were issued describing conditions over the California-Hawaii flying routes and were given wide publicity by the various news-gathering agencies. The following, which was handed to Lieutenants Maitland and Hegenberger the evening before their departure, is a sample of the information the bulletins contained:

Very stable atmospheric conditions prevail over the California-Hawaii airway and conditions are ideal for flight from this coast to the islands. From the islands to the one hundred and fortieth meridian winds will be moderate to fresh easterly during the next 36 hours and the weather partly cloudy with showers near the islands; from the one hundred and fortieth to the one hundred and thirtieth meridians, moderate north and northeast and partly cloudy; from the one hundred and thirtieth meridian to the coast fresh northerly and clear, winds increasing to strong north of Point Conception.

Reports from vessel weather stations and the testimony of the flyers themselves indicate that the conditions experienced were substantially as forecast.

No storm warnings were issued, and southerly gales on the Washington coast and Puget Sound on the 25th occurred without warning. They were associated with a disturbance in the Gulf of Alaska which appeared from data on the weather chart to be of only ordinary intensity, and which displayed no characteristics justifying the display of flags.

The fire hazard was subnormal for the most part, and most of the warnings which were issued related to the danger of fire arising from lightning storms. The hazard in northern California, however, increased markedly during the closing days of June, consonantly with the reconstruction of the oceanic high-pressure system and its ensuing invasion of the forecast district on the 27th. Effective warnings of this development were issued for the areas affected.—*T. R. Reed.*

RIVERS AND FLOODS

By R. E. SPENCER

In addition to the continuation of the Illinois River flood and the great flood in the Mississippi River and to scattered minor rises in the interior rivers of Ohio, Colorado, and California, important floods occurred in the Wabash system of Indiana, the streams of the St. Louis, Mo., district, the lower Arkansas and its tributaries, the Rio Grande, and the Columbia River System. Report on the floods of the Mississippi and the St. Louis district, including the Illinois, and that in the Columbia (which had not subsided at the close of the month) will be made later; the others having results of any consequence are discussed below:

Wabash system.—Heavy rain on May 18 and 19, when the streams were already comparatively full, resulted in a rise to flood stage over practically the entire Wabash River and in the main stream and West Fork of the White; and further showers thereafter continued the flood stages well into the first decade of June. Warnings were issued well in advance of the flood and were accurately verified, resulting in a saving in movable property estimated at $35,000. Unavoidable losses were as follows: Tangible property, $5,000; prospective crops, $191,600; suspension of business, $26,300. Owing to the lateness of the season, the delay in planting occasioned by this rise will doubtless result in a considerable reduction in some crops.

Topeka, Kans., district.—Of the floods in this district the official in charge of the Weather Bureau office at Topeka reports as follows:

> June, 1927, was marked by overflows in the basins of the Solomon, Saline, Smoky Hill, Osage (Marais des Cygnes), Cottonwood, and Neosho Rivers in Kansas. The chief damage was to growing crops, especially wheat and corn. Wheat was approaching maturity and the high water came too late to replant corn. Approximately 50,000 acres of crop land were flooded, much of it for several days. The estimated damage by river basins was as follows: Solomon Basin, $70,000; Smoky Hill Basin, including the Saline Basin, $20,000; Cottonwood Basin, $100,000; Neosho Basin, $350,000. The damage in the Osage Basin was small as the high water there lasted only a day or two.

The two overflows in the upper Solomon River at Beloit, Kans., caused comparatively little loss, but the later flood of this stream (from June 13 to 16) resulted in heavy crop damage. The official at Topeka reports further that the most important rise of the month was that which began in the Cottonwood, Neosho, and Osage Rivers after heavy rains on the night of June 18–19, whose effect was augmented by another heavy downfall on the night of 19–20. Warnings were in the main ample and very well verified.

Fort Smith and Little Rock, Ark., districts.—The effect of the floods in Kansas and of heavy local rains from June 17 to 24, was reflected in the lower Neosho River and the Arkansas River between Wyandotte, Okla., and Fort Smith, Ark., in the overflow of about 500 acres of land. Resultant damage amounted to about $10,000. But in the Verdigris Basin of Kansas—mainly Montgomery County—considerably greater damage occurred, 25,000 acres of land having been inundated, with the following resultant losses: Prospective crops, $150,000; mature crops, $50,000; real property, $2,500.

In the Lttle Rock, Ark., district no direct destruction by the floods is reported; but they of course prolonged the inundation of lands still under water from the great flood of the previous months, so that for the most part planting in the affected area will have to be abandoned for the 1927 season.

Rio Grande.—The official in charge of the Weather Bureau office at Brownsville, Tex., reports that—

> heavy to excessive rains from the 22d to about the 25th of June, extending from Starr County evidently across the Rio Grande into the watershed of the San Juan River of northern Mexico, caused a flood of considerable proportions during the last decade of June in the Rio Grande from Riogrande, Tex., to the mouth of the river.

Figures on the losses occasioned by this rise were very incomplete, but—

> according to reports, Willacy County, beyond the control levees, suffered the greatest acreage of inundation. Cameron County came next with considerable lands flooded, especially toward the coast and in the coast sections, while comparatively small acreages were flooded in Hidalgo and Starr Counties. Probably between one-third and one-half of the lands flooded were under cultivation and in crops, and the total monetary value of the various damages and losses from this flood, it is believed, will go well over $150,000.

Reports as to the value of Weather Bureau warnings were also very few, but those received indicate a saving of at least $50,000 in mature crops and livestock, and prove that the advices were of value as an aid to irrigation companies in preparing for the approaching flood.

This report is further interesting from the point of view of effective flood control by levees:

> Although, apparently, the volume of water passing Riogrande, Tex., during this flood was considerably greater than that of the average flood that comes to the Rio Grande Valley, and equal to some of the serious Rio Grande floods of the past, the flood control levees (in an advanced stage of construction now) in Hidalgo and Cameron Counties controlled the great volume of water and prevented a repetition of the widespread inundations of the past from a similar volume of water. In the main only lowlands in sections where the levees are yet unfinished, and of course lands between the control levees—a total of many thousand acres—were inundated.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI DRAINAGE					
Ohio:	*Feet*			*Feet*	
Mount Vernon, Ind.	35	3	7	36.0	June 6
Shawneetown, Ill.	35	(1)	10	39.7	6
Cairo, Ill.	45	2	14	49.7	9
Tuscarawas: Gnadenhutten, Ohio	9	5	6	9.3	5
Walhonding: Walhonding, Ohio	8			10.7	4
Hocking: Athens, Ohio	17	12	12	17.2	12
Scioto: Circleville, Ohio	10	6	6	11.0	6
Kentucky: Beattyville, Ky.	30	(1)	1	34.8	May 31
Wabash:					
Lafayette, Ind.	11	5	7	13.6	June 6
Covington, Ind.	16	(1)	(2)	24.1	May 21–22
		6	7	17.0	June 7
Terre Haute, Ind.	16	(1)	2	20.9	May 30
Vincennes, Ind.	14	(1)	10	22.3	June 2
Mount Carmel, Ill.	16	(1)	12	24.8	2
Tippecanoe: Norway, Ind.	6	(1)	13	6.5	May 19, June 4, 5, 7
		23	23	6.1	23
White: Decker, Ind.	18	(1)	5	22.9	1
White, West Fork: Edwardsport, Ind.	15	(1)	3	18.4	May 26, 30
Holston: Rogersville, Tenn.	14		(2)	17.2	31
Mississippi:					
Quincy, Ill.	14	(1)	(2)	15.3	26
		4	8	16.5	June 6
Hannibal, Mo.	13	(1)	10	17.0	6
Louisiana, Mo.	12	(1)	10	15.8	6
		13	16	13.7	14
Grafton, Ill.	18	(1)	18	22.8	8
Alton, Ill.	21	(1)	19	26.9	8
St. Louis, Mo.	30	4	11	33.0	8
		15	15	30.0	15
Chester, Ill.	27	(1)	18	30.6	9
Cape Girardeau, Mo.	30	(1)	20	35.6	9
New Madrid, Mo.	34	1	19	39.4	10–11
Cottonwood Point, Mo.	34	5	17	36.2	12
Memphis, Tenn.	35	7	22	39.0	14–15
Helena, Ark.	44	8	25	48.0	16–18
Vicksburg, Miss.	45	(1)	(2)	58.7	May 4
Natchez, Miss.	46	(1)	(2)	56.5	1, 4
Angola, La.	45	(1)	(2)	57.5	15–17
Baton Rouge, La.	35	(1)	(2)	47.8	15
Donaldsonville, La.	28	(1)	(2)	37.1	May 15–17
New Orleans, La.	17	(1)	12	21.0	Apr. 25
Illinois:					
Morris, Ill.	13	4	6	16.9	June 5
Peru, Ill.	14	(1)	26	22.8	May 26
Henry, Ill.	10	(1)	25	17.4	28
Peoria, Ill.	18	(1)	21	23.9	28
Havana, Ill.	14	(1)	(2)	22.05	June 8
Beardstown, Ill.	14	(1)	(2)	25.2	Apr. 26
Pearl, Ill.	12	(1)	(2)	22.7	26–27
Meramec:					
Steelville, Mo.	12	2	2	17.8	June 2
Pacific, Mo.	11	(1)	6	19.6	4
Valley Park, Mo.	14	(1)	6	22.3	4
St. Francis:					
St. Francis, Ark.	17	(1)	17	26.4	Apr. 18
Marked Tree, Ark.	17	(1)	18	20.1	May 10
Missouri:					
Blair, Nebr.	16	21	(2)	16.8	June 26
Hermann, Mo.	21	5	7	21.8	7
St. Charles, Mo.	25	4	10	27.6	7
		14	14	25.2	14
		23	28	26.0	25
Smoky Hill:					
Mentor, Kans.	22	23	25	23.8	25
Solomon, Kans.	24	19	23	26.4	21
Saline: Tescott, Kans.	27	18	20	28.1	18
Solomon:					
Beloit, Kans.	18	5	7	25.2	7
		13	16	23.0	16
Niles, Kans.	26	19	20	26.9	20
Grand, West Fork: Gallatin, Mo.	20	4	5	20.1	4
Grand:					
Chillicothe, Mo.	18	4	6	25.6	6
Brunswick, Mo.	12	6	7	12.5	17
		14	15	12.2	15
Grand, Thompsons Fork: Trenton, Mo.	20	4	4	20.2	4
Osage:					
Quenemo, Kans.	30	20	21	31.1	20
Osceola, Mo.	20	21	23	23.9	22
Warsaw, Mo.	22	2	4	26.6	3
		21	24	26.1	21
Tuscumbia, Mo.	25	2	6	32.15	4
		24	25	25.95	24
Arkansas:					
Webbers Falls, Okla.	23	23	23	23.1	23
Fort Smith, Ark.	22	23	23	22.5	23
Dardanelle, Ark.	20	24	25	20.2	24
Yancopin, Ark.	20	(1)	(2)	48.5	Apr. 20
Neosho:					
Leroy, Kans.	24	19	20	25.1	June 19
Iola, Kans.	15	20	21	17.0	20
Oswego, Kans.	17	19	27	22.4	22
Fort Gibson, Okla.	22	21	23	24.0	22
Cottonwood:					
Elmdale, Kans.	32	20	20	34.4	20
Emporia, Kans.	20	21	24	24.5	22
Canadian: Logan, N. Mex.	4			6.0	13

[1] Continued from last month.
[2] Below flood stage at 8 a. m., June 1.
[3] Continued at end of month.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI DRAINAGE—continued					
Petit Jean: Danville, Ark.	*Feet* 20	2	8	*Feet* 22.5	June 7
		22	22	20.0	22
White:					
Calico Rock, Ark.	18	21	21	22.5	21
Batesville, Ark.	23	4	4	23.6	4
		22	22	26.8	22
Newport, Ark.	26	5	11	27.8	8
		23	23	26.1	23
Georgetown, Ark.	22	7	15	22.5	11–13
Black:					
Leeper, Mo.	11	1	2	13.8	1
Williamsville, Mo.	11	1	1	16.2	1
Poplar Bluff, Mo.	14	2	6	18.0	3
Corning, Ark.	11	(1)	28	16.2	Apr. 18
Black Rock, Ark.	14	Mar. 18	29	30.2	15
Cache: Patterson, Ark.	9	June 9	20	9.7	June 14–16
		27	(2)		
Yazoo: Yazoo City, Miss.	25	(1)	(2)	37.4	May 5
Tallahatchie: Swan Lake, Miss.	25	(1)	8	31.8	Mar. 22
Sulphur: Ringo Crossing, Tex.	20	24	25	21.1	June 25
Ouachita: Monroe, La.	40	(1)	17	48.2	May 4
Atchafalaya:					
Melville, La.	37	(1)	13	46.8	14–16
Morgan City, La.	8	(1)	25	9.7	June 10
WEST GULF DRAINAGE					
Little: Little River, Tex.	30	14	15	37.7	13
Rio Grande:					
San Marcial, N. Mex.	2	(1)	5	3.8	May 9, 10, 21
		11	20	3.6	June 13
Riogrande, Tex.	21	22	24	29.8	23
		26	27	24.0	27
Mission, Tex.	22	24	29	24.6	25
San Benito, Tex.	23	24	(2)	24.6	25
Brownsville, Tex.	18	20	(2)	18.4	28
PACIFIC DRAINAGE					
Colorado: Parker, Ariz.	7	(1)	(2)	10.0	May 28, June 24, 26
Colorado, Roaring Fork:					
Carbondale, Colo.	5	8	11	5.1	11
		27	28	5.5	28
Gunnison: Delta, Colo.	9	9	11	9.2	9–10
		16	17	9.6	16
		19	20	9.0	19–20
		28	29	10.0	28
San Juan: Farmington, N. Mex.	8	29	30	14.0	30
San Joaquin: Friant, Calif.	12	14	14	12.0	14
Kings: Piedra, Calif.	12	7	8	12.5	7
		13	17	12.5	14
Columbia:					
Marcus, Wash.	24	4	(2)	32.2	19–20
Vancouver, Wash.	15	(1)	(2)	23.9	18–20
Kootenai: Bonners Ferry, Idaho	26	10	21	30.1	14
Pend O'Reille: Newport, Wash.	16	4	(2)	23.7	22–23
Clearwater: Kamiah, Idaho	14	7	11	15.2	8
Willamette: Portland, Oreg.	15	(1)	(2)	23.0	19–20

[1] Continued from last month.
[2] Below flood stage at 8 a. m., June 1.
[3] Continued at end of month.

MEAN LAKE LEVELS DURING JUNE, 1927

By United States Lake Survey

[Detroit, Mich., July 6, 1927]

The following data are reported in the "Notice to Mariners" of the above date:

Data	Lakes [1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during June, 1927:	*Feet*	*Feet*	*Feet*	*Feet*
Above mean sea level at New York	602.33	579.43	572.20	246.11
Above or below—				
Mean stage of May, 1927	+0.37	+0.29	+0.25	+0.16
Mean stage of June, 1926	+1.83	+1.02	+0.96	+0.80
Average stage for June, last 10 years	+0.45	−0.83	−0.29	−0.27
Highest recorded June stage	−1.10	−4.17	−2.32	−2.52
Lowest recorded June stage	+1.83	+1.02	+1.02	+1.22
Average departure (since 1860) of the June level from the May level	+0.27	+0.23	+0.18	+0.14

[1] Lake St. Clair's level: In June, 1927, 574.73 feet.

EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, JUNE, 1927

By J. B. KINCER

General summary.—Droughty conditions were relieved in the Southeast the first part of the month, but some areas still had need of moisture, especially southern Florida. Further rains in the central valley States delayed farm work, but conditions were better in the Lake region and the Northwest. Growth of vegetation was slow over the northern part of the country because of the prevailing cool weather, but higher temperatures in the far Northwest promoted better growth of crops, while in the South excellent growth was made wherever moisture was sufficient.

During the second decade marked improvement in weather conditions was noted, notwithstanding continued coolness in the northern sections and in the interior valleys, where corn planting had become seriously delayed because of preceding wet weather. Most of the period was fair and work was pushed. In the Southwest widespread and generous rains near the middle of the period brought relief from the severe drought and unusually favorable conditions prevailed in the Northern States west of the Rocky Mountains where vegetation responded favorably.

Aside from slow growth of warm-weather crops, because of continued subnormal temperatures, in the area from the Ohio Valley northward, the weather during the last decade was decidedly better than had previously prevailed for both progress of crops and farm work. In the Atlantic Coast States conditions were generally favorable, but in the Southeast additional rainfall hindered cultivation, resulting in considerable complaint of grassy fields; dry weather continued in southern Florida. In the Wheat Belt the bright, sunny and practically rainless weather produced ideal conditions for harvest.

Small grains.—In Kentucky, Indiana, and Illinois, conditions were mostly unfavorable for best development of winter wheat during the first decade because of too much moisture and cloudy weather, but elsewhere in the main producing sections progress was mostly very good. The crop was spotted in much of the Southwest, but continued very good in the eastern half of Kansas and excellent reports were received from Nebraska. The weather was favorable during the first part of the second decade, but much rust was reported in parts of central sections. Winter wheat ripened slowly in the Great Plains. Frequent rains delayed harvest the latter part of the second decade in the southern portion of the belt with wheat ready to cut north to central Kansas. During the last decade harvest made excellent advance in practically all portions of the belt with cutting advancing in the East to Maryland and in the West to northern Kansas. Spring wheat had mostly favorable weather during the entire month and made good progress generally with the crop beginning to head in early fields of North Dakota at the close. Oats did well in most northern areas and, except for some spottedness in parts of the interior valleys, condition was fair to good. Rice and flax advanced favorably and some buckwheat had been sown in New York at the close.

Corn.—Seeding was delayed the first part of the month, due to continued rains and wet soil, in much of the central portion of the belt. In eastern and southeastern Iowa, central and southern Illinois, and in much of Indiana and Kentucky planting was especially delayed. The latter part of the first decade, however, had much better weather conditions and excellent progress was made in those sections where work had been seriously delayed. Rain again interrupted planting about the middle of the second decade, but seeding had been largely completed in many places in Ohio, was mostly finished in Kentucky, and fairly well advanced in the West. During the latter part of the second decade more favorable weather again prevailed and considerable planting was accomplished, but persistent cool weather resulted in poor germination and growth. Weather conditions during the last decade caused considerable improvement to the corn crop, although it continued too cool for good growth. In Iowa the state of the crop varied greatly with some just planted and not up in the southeast to laid by in some fields of the southwest. At the close of the month warm, dry weather was generally needed from the central and northern Mississippi Valley States eastward.

Cotton.—Beneficial rains occurred in much of the eastern and the western portions of the Cotton Belt the first part of the month and in the east and southeast fair to excellent progress was made. In central portions of the belt advance was poor to excellent, but in Oklahoma generally good stands and progress were reported with planting about completed. Progress was generally good in Texas. During the second decade the weather was mostly favorable, except for some complaint of grassy fields, due to frequent showers. Progress was still fairly good to excellent in eastern portions, but weevil activity was reported from parts of this area and also in central districts. In western portions cotton made fair to very good advance. There was considerable complaint of weevil activity in southeastern portions during the last decade, extending west as far as the Mississippi Valley and locally in Arkansas and Oklahoma. Continued rains prevented needed cultivation in the lower Mississippi Valley and from Alabama eastward, but otherwise conditions were generally favorable with growth of plants mostly fair to very good.

Ranges, pastures, and livestock.—In most northern areas pastures and ranges were generally excellent during most of the month. The dry conditions in the southeast were relieved and pastures showed considerable improvement, while in the southwest fairly general rains were also of great benefit to the range. Drought continued in southern New Mexico, but elsewhere in the great western grazing districts ranges were mostly good. Livestock continued in satisfactory condition throughout the month and haying was favored generally, except for some local loss of hay due to rain.

Miscellaneous crops.—Potatoes did well generally with setting sweet potatoes finished in some southern portions at the close of the month. Truck crops were somewhat backward in the northeast and the northwest, but were otherwise doing well. Tobacco showed improvement during the month and at the close transplanting was well advanced in Wisconsin. Much sugar cane was lost by flooding in Louisiana, but where not flooded the crop was excellent. Sugar beets were making satisfactory advance with thinning progressing at the close of the month. Fruit showed variable advance, with heavy drop reported from some sections, but citrus showed improvement in Florida.

WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

June is normally one of the quietest months over the North Atlantic, and June, 1927, was no exception to the general rule. Judging from reports received up to date, gales did not occur in more than two days in any 5° square, and were fairly well distributed over the ocean north of the fortieth parallel. For the most part these gales were comparatively moderate; the highest force of wind usually not exceeding 8 or 9, although a few vessels encountered a maximum force of 10, as shown by the gale reports in table on pp. 286.

As is usually the case in June, fog was very prevalent, occurring on from 16 to 18 days over the Grand Banks and Nantucket shoals; it was reported on 13 days along the American coast, between Hatteras and New York, and on from 2 to 4 days over the steamer lanes, east of the fortieth parallel, while the European coast was comparatively clear, except that it was reported on 4 days in the vicinity of the Gulf of Cadiz.

TABLE 1.—*Averages, departures and extremes of atmospheric pressure at sea level, 8 a. m. (75th meridian), North Atlantic Ocean, June, 1927*

Stations	Average pressure	Departure [1]	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Belle Isle, Newfoundland	29.84	0.00	30.22	9th	29.38	14th.
Halifax	29.97	+0.03	30.36	18th	29.58	6th.
Nantucket	29.99	0.00	30.30	18th	29.62	11th.
Hatteras	30.02	+0.01	30.28	28th	29.80	11th.
Key West	30.00	+0.01	30.10	23d [2]	29.94	21st.
New Orleans	30.01	+0.06	30.18	29th	29.86	21st.
Swan Island	29.89	+0.02	29.98	7th	29.80	21st.
Turks Island	30.10	+0.09	30.16	23d	30.02	20th.
Bermuda	30.13	+0.03	30.28	8th [2]	30.04	1st.
Horta, Azores	30.02	+0.01	30.28	28th	29.80	11th.
Lerwick, Shetland Islands	29.75	−0.05	30.20	15th	29.36	19th. [2]
Valencia, Ireland	29.97	−0.03	30.18	22d	29.54	30th.
London	29.92	−0.01	30.24	22d	29.54	26th.

[1] From normals shown on H. O. Pilot Chart based on observations at Greenwich mean noon, or 7 a. m., 75th meridian.
[2] And on other dates.

Charts VIII to IX show the conditions on June 4 and 5 and Charts X and XI for the 29th and 30th. The first two charts are presented to give an idea of the weather encountered during the trans-Atlantic airplane flight of Messrs. Chamberlin and Levine, and the last two for that of the plane in charge of Commander Byrd.

As stated before, there were few well-defined disturbances during the month, although on a number of days gales were reported by vessels in widely scattered sections of the ocean.

On the 6th there was a fairly well-defined storm area between the 35th and 45th parallels and the 50th and 60th meridians.

On the 15th and 16th moderate to strong westerly gales swept the steamer lanes between the 40th and 55th parallels and the 20th and 40th meridians.

NOTE.—Capt. F. G. Pooley, Honduran S. S. *Morazan*, reports as follows:

On June 7th, while at Vera Cruz, wind N. force 3, Nb. 8, moving from N. between 9 and 9.30 a. m., 90th meridian time, and about 4 miles out at sea in an E. direction from the harbour and on the fore part of the clouds, I saw three waterspouts form. The first and second formed in the clouds and descended straight down in the form of an inverted cone, the sea being violently agitated and rising as a dense smoke, especially after the spout had reached the sea. They then increased in thickness until they resembled a huge black pillar. The third was very thin and formed in the shape of an acute angle, then gradually bent into a semicircle. The first spout, about three minutes before dissolving, palpitated in the middle between sky and sea as if it were breathing, throwing off at the same time what appeared to be like smoke. I noticed these spouts to dissolve from the sea and be drawn up into the clouds the reverse way to which they formed. The clouds appeared to be about 1,500 feet high.

OCEAN GALES AND STORMS, JUNE, 1927

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				*Inches*					
Balsam, Am. S. S.	Liverpool	Boston	52 15N.	38 30W.	June 3	4a, 3d	June 4	29.54	S.	SW., 7	W.	W., 8	S-SW.
New York, Ger. S. S.	New York	Hamburg	43 19N.	41 10W.	5	Mdt. 5th	6	29.94	NNE.	NE., 9	NW.	NW., 9	NE-NNE.
Julius Schindler, Ger. S. S.	Houston, Tex.	Ghent	38 54N.	55 33W.	5	Noon, 6th	6	29.87	SE.	S., 7	SW.	SE., 9	S-SW.
Coeur d'Alene, Am. S. S.	Casa Blanca	New York	36 00N.	35 01W.	6	4p, 8th	8	29.97	S.	S., 6	N.	—9	W-NW-N.
Ossa, Am. S. S.	Alexandria	Boston	40 22N.	24 53W.	12	8a, 12th	12	29.82	W.	W., 8	WNW.	W., 8	
Medoc, U. S. S.	On ice patrol.		45 30N.	41 30W.	14	9p, 14th	16	29.48	WSW.	W.	NNE.	W., 9	WSW-W.
Persephone, Danzig S. S.	Rotterdam	New York	44 00N.	39 00W.	15	6a, 15th	17	29.62	W.	W., 6	NW.	WSW., 9	W-WSW.
Hardenberg, Du. S. S.	Montreal	Rotterdam	51 12N.	26 07W.	15	Noon, 15th	15	28.86	SSE.	SW., 9	SW.	SW., 10	SSE-SW.
San Nazario, Br. S. S.	Curacao	Southampton	41 28N.	28 35W.	15	Noon, 16th	17	29.81	SW.	W., 7	WNW.	WNW., 8	SW-WNW.
Oscar II, Dan. S. S.	New York	Christiansand	56 30N.	18 10W.	16	10p., 16th	17	28.89	WSW.	S., 8	S.	S., 8	W-SW-SSE.
Coelleda, Am. S. S.	Belfast	New York	54 44N.	14 05W.	17	2p, 17th	19	29.40		SW.	W.	—8	SW-W.
Kerhonkson, Am. S. S.	Dublin	Baltimore	48 46N.	26 40W.	19	4p, 19th	19	29.72	NNE.	NNE., 8	N.	N., 9	NNE-N.
Ossa, Am. S. S.	Alexandria	Boston	42 37N.	67 24W.	20	8p, 20th	21	29.80	E.	NE., 8	NE.	NE., 8	
Bannack, Am. S. S.	Liverpool	do	51 16N.	13 53W.	20	Noon, 20th	21	29.74	SW.	SW., 8	WNW.	SW., 8	SW-WNW.
Innoko, Am. S. S.	Rotterdam	New York	41 16N.	66 23W.	20	2a, 21st	21	29.66	SE.	NE., 7	W.	E., 8	ESE-NNE.
Clontarf, Am. S. S.	New York	Malta	38 42N.	19 23W.	21	8p., 21st	23	30.15	NE.	NE., 7	NE.	NE., 8	Steady.
West Noska, Am. S. S.	Liverpool	Boston	Liverpool Bay.		25	8p, 25th	26	29.45	W.	W., 8	NW.	W., 8	Steady.
West Madaket, Am. S. S.	English Channel.	Galveston	49 45N.	3 45W.	25	4a, 26th	27	29.66	WSW.	NW., 8	NNW.	NW., 8	WSW-NW
Galtymore, Br. S. S.	Liverpool	Boston	53 29N.	29. 28W.	29	3a, 29th	30	29.92	NNW.	NNW., 10	NW.	WNW., 10	Steady.
Motocarline, Belg. S. S.	New York	Antwerp	40 32N.	53 50W.	29	10a, 29th	30	30.08	SE.	S., 8	SE.	SE., 8	
Notre Dame de Fourviere, Fr. S. S.	Curacao	Havre	47 50N.	16 40W.	28	4a, 30th	30	29.68	NNE.	NW., 6	NW.	NNW., 8	
NORTH PACIFIC OCEAN													
China Arrow, Am. S. S.	Hong Kong	San Pedro	33 48N.	137 19E.	3	4p, 5th	5	29.44	E.	NNE., 8	NNE.	NE., 9	None.
City of Vancouver, Br. S. S.	Nagoya	Grays Harbor.	48 51N.	163 30W.	7	—8th	9	28.49	E.	SSE., 4	SW.	E., 10	
China Arrow, Am. S. S.	Hong Kong	San Pedro	47 00N.	161 10W.	15	9a, 16th	16	29.63	SE.	SSW., 7	W.	S., 8	Do.
West Ison, Am. S. S.	Tsingtau	Seattle	49 37N.	140 08W.	24	—24th	24	29.80	NW.	NW., 7	NW.	NW., 8	Do.
Oakridge, Am. S. S.	Westport	Fushiki	51 33N.	172 31W.	23	2p, 25th	26	29.26	SE.	W., 7	WNW.	WSW., 9	Do.
West Elcajon, Am. S. S.	Otaru	San Francisco	38 40N.	124 50W.	28	Mdt., 29th	29	29.90	NW.	NNW., 8	NNW.	NNW., 8	NW-NNW.
Tsuyama Maru, Jap. S. S.	San Francisco	Balboa	17 20N.	102 18W.	28	5a, 28th	29	29.78	SE.	E., 8	E.	E., 8	3 points.
Llo, Am. M. S.	San Pedro	do	17 20N.	101 48W.	28	5a, 28th	29	29.94	SE.	SE., 9	E.	SE., 9	SE-ESE.
Sonoma, Am. S. S.	Sydney	San Francisco	36 57N.	126 18W.	29	—, 30th	30	30.10	ENE.	N., 8		NNE., 9	4 points.
Yankee Arrow, Am. S. S.	San Pedro	Balboa	18 30N.	104 10W.	30	—, 30th	July 1	29.83	E.	SE., 8	SE.	SE., 8	E-SE-S.
SOUTH PACIFIC OCEAN													
Scapas, Du. T. S.	San Pedro	Sydney	31 15S.	157 32E.	4	9a, 5th	June 5	28.81	NE.	S., 11	SW.	S., 11	
Inverarder, Br. T. S.	Bahia Blanca	San Pedro	43 45S.	81 20W.	6	6p, 6th	8	29.23	N.	N., 10	SW.	N., 10	NNW-W.
SOUTH ATLANTIC OCEAN													
Oregon, Dan. M. S.	Rotterdam	Buenos Aires	28 08S.	46 34W.	4	8p, 4th	5	29.94	S.	S.	SSE.	S., 8	S-SSE.
Arundo, Du. S. S.	Mobile	do	34 36S.	53 04W.	6	5p, 7th	7	29.87	ENE.	WNW., 8	WNW.	WNW., 8	ENE-WNW.
Alchiba, Du. S. S.	Rotterdam	do	33 42S.	32 18W.	10	10a, 11th	12	29.26	NE.	NW., 7	SW.	SE., 11	NW-SE-S.
INDIAN OCEAN													
Kendal Castle, Br. S. S.	Colombo	Suez	11 33N.	53 10E.	2	3a, 3d	3	29.71	SW.	SSW., 8	SSW.	SSW., 9	SW-SSW.
Ensley City, Am. S. S.	Port Lincoln	Aden	9 04N.	51 55E.	8	2a, 8th	8	29.58	SW.	SW., 7		SW., 9	None.
Dundrum Castle, Br. S. S.	Algoa Bay	New York	30 44S.	30 30E.	14	4p, 14	15	29.87	SW.	WSW., 8	W.	WSW., 8	SW-WSW

NORTH PACIFIC OCEAN

By WILLIS E. HURD

The one important phase of the meteorological conditions on the North Pacific Ocean for June, 1927, was the extraordinary vitality and depth for the season of the Aleutian LOW. Ordinarily the LOW has largely disintegrated by this time of year, but now it persisted until near the end of June, the average pressures at Dutch Harbor and St. Paul, 29.60 and 29.64 inches, respectively, being the lowest of the month in recent years, and near the lowest normal readings for the time of strongest development of the LOW in November and December.

The North Pacific anticyclone lay over the middle-eastern part of the ocean practically throughout the month, with little change from the normal in position, its center being near 35° N., 145° W. Its average pressure for the month was slightly below normal; hence for the whole eastern part of the ocean north of the 30th parallel abnormally low pressures prevailed.

The following table is illustrative of the barometric conditions at several island and coast stations in west longitudes:

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean, June, 1927*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Dutch Harbor [1] [2]	29.60	−0.39	30.14	28th	29.00	8th.
St. Paul [1] [3]	29.64	−0.25	30.04	28th	29.26	25th.
Kodiak [1] [2]	29.79	−0.15	30.26	30th	29.50	21st.
Midway Island [1]	30.10	+0.03	30.20	16th	29.86	26th.
Honolulu [4]	30.04	0.00	30.12	15th	29.90	20th.
Juneau [4]	29.97	−0.04	30.26	30th	29.63	25th.
Tatoosh Island [4] [5]	30.04	−0.01	30.39	27th	29.69	25th.
San Francisco [4] [5]	29.93	−0.03	30.13	27th	29.73	15th
San Diego [4] [5]	29.91	+0.02	30.06	5th	29.74	25th.

[1] P. m. observations only.
[2] For 29 days.
[3] For 27 days.
[4] A. m. and p. m. observations.
[5] Corrected to 24-hour mean.

Notwithstanding the activity of the Aleutian LOW, June was for the most part a very quiet month. Along the upper sailing routes gales were infrequent and rarely of forces exceeding 8 or 9. The highest wind velocity experienced in these latitudes at sea was an easterly gale of force 10 which occurred on the 8th near 49° N., 163°

W. On the coast it was exceeded at the Weather Bureau station at Tatoosh Island, Wash., when a 69-mile south wind (force 11) was recorded on the 25th.

In the Far East a typhoon, which originated in May, moved northward, then northeastward from Taiwan early in the month, and died out at sea east of Japan on the 6th. The gale report of the American steamer *China Arrow* has to do with the typhoon as it lay off the south coast of Japan on the 5th. A more detailed account of the storm will be found in the article immediately following this in the REVIEW. During the remainder of the month only a few unimportant depressions occurred over this part of the Pacific.

In the American Tropics east and southeast gales of force 8 to 9 were encountered by steamers off the Mexican coast between Acapulco and Manzanillo from the 28th to the 30th. It is believed, from a consideration of their direction, coupled with the fact of their progressive northward movement, although little depression of the barometer was observed, that a small cyclone may have been moving up the coast to seaward of the reporting vessels.

This June at Honolulu was the second driest and the third windiest on record. The average hourly velocity was 9.7 miles, but the maximum velocity was at the rate of only 28 miles an hour, from the northeast, on the 6th. The prevailing direction was east.

Fog was frequent and not far from normal in occurrence from southern California up the coast, and thence westward north of the 40th parallel to the Asiatic coast. Several vessels, sailing eastward from Japanese ports, encountered fog daily from time of departure until they were beyond midocean. The region from 40° to 50° N., lying between the western Aleutians and Japan, was one of three areas of maximum fog—over 50 per cent—shown on the current June chart. Of the other two, one lay over the eastern part of Bering Sea; the other off the California coast between San Diego and the 40th parallel. The American steamer *China Arrow*, reporting on fog observed at the northern entrance to Taiwan Channel on the 1st, said that although the sky was clear overhead, one "could not see a ship's length" ahead from the deck of the vessel.

NOTES

Attention is here called to two intense cyclonic storms of the Southern Hemisphere—not to mention others of a seemingly minor nature—which the accompanying gale reports show to have occurred:

South Pacific Ocean.—The Dutch tanker *Scapas* was caught in the southeastern quadrant of a cyclone not far from Lord Howe Island, a few hundred miles off the eastern coast of Australia, during the afternoon of June 5. The cyclone, which had a known violence of force 11, appeared to be moving southeastward, since the vessel in its westward voyage to Sydney, encountered on the 6th the gales belonging to the northwest quadrant.

South Atlantic Ocean.—A violent cyclone occurred off the extreme lower Brazilian and the Uruguayan coast on June 10 to 12, as indicated by the report of the Dutch Steamer *Alchiba*. The storm was apparently moving south or southeast, and was of close to hurricane intensity.

TYPHOONS AND DEPRESSIONS

TWO TYPHOONS IN THE PHILIPPINES AT THE END OF MAY AND BEGINNING OF JUNE, 1927

By Rev. José Coronas, S. J.
[Weather Bureau, Manila, P. I.]

There were only two typhoons over the Philippines during the months of May and June, the rest of the two months having been remarkably calm even in the whole Far East.

Typhoon over Luzon: May 26.—This typhoon was probably formed about 600 miles to the east of San Bernardino Strait in about 12° latitude N., between 133° and 134° longitude E. It moved WNW. and reached Luzon during the night of the 25th. The center traversed Luzon rather deformed with signs of being divided into two centers when it reached the China Sea between 16° and 17° latitude N. and about 120° longitude E. The typhoon moved to the north on the 27th and 28th, and to NW. by N. on the 29th and 30th. On the 28th and 29th it moved very slowly to the west of Balintang Channel. The position of the center at 6 a. m. of the 27th to 31st was as follows:

May 27, 6 a. m., 118° 45′ longitude E., 17° 15′ latitude N.
May 28, 6 a. m., 118° 50′ longitude E., 19° 20′ latitude N.
May 29, 6 a. m., 118° 45′ longitude E., 20° latitude N.
May 30, 6 a. m., 118° 10′ longitude E., 21° 05′ latitude N.
May 31, 6 a. m., 115° 40′ longitude E., 23° 50′ latitude N.

It was due to the influence of this typhoon that the interisland steamer *Negros* was wrecked on May 26 south of Luzon near to the north of Romblon with the loss of about 60 or 70 lives.

Typhoon over Batanes Islands and Formosa: June 2 and 3.—This typhoon appeared on our Weather Maps on May 26th and 27th to the south of Yap in about 138° longitude E, between 6° and 7° latitude N. The typhoon moved to WNW. and NW. on the 27th to 29th, and to NNW. on the 30th; then it inclined again to WNW. on the 31st. On June 2, when the center was over the Balintang Channel between 122° and 123° longitude E, and in about 20° latitude N., there was a new change in the direction to NNW., the center passing over the Batanes at about 10 a. m. of the 2d and over Formosa on the 3d. The barometric minimum recorded at Basco, Batanes Islands, was 729.62 mm. at 10:30 a. m. of June 2. At about noon of June 3 the typhoon recurved northeastward.

The position of the typhoon at 6 a. m. of May 31 and June 1 to 6 was as follows:

May 31, 6 a. m., 128° 40′ longitude E., 16° 45′ latitude N.
June 1, 6 a. m., 125° 55′ longitude E., 17° 45′ latitude N.
June 2, 6 a. m., 122° 30′ longitude E., 19° 55′ latitude N.
June 3, 6 a. m., 120° 50′ longitude E., 23° 30′ latitude N.
June 4, 6 a. m., 124° 50′ longitude E., 27° latitude N.
June 5, 6 a. m., 132° longitude E., 30° 25′ latitude N.
June 6, 6 a. m., 147° 50′ longitude E., 34° 40′ latitude N.

CLIMATOLOGICAL TABLES[1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the station reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, June, 1927

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	78.2	−0.1	2 stations	102	[2] 4	Riverton	55	16	5.28	+1.02	Florence	9.57	Eufaula	2.05
Arizona	75.2	−1.2	2 stations	117	23	Alpine	22	3	1.16	+0.81	Walnut Creek	7.24	9 stations	0.00
Arkansas	76.3	−0.8	Amity	104	[2] 25	Dutton	43	16	6.50	+2.48	Hot Springs	14.57	Huttig	2.70
California	67.6	+0.2	Greenland Ranch	122	23	2 stations	20	[2] 1	0.40	+0.09	Cuyamaca	2.37	42 stations	0.00
Colorado	60.6	−0.6	Lamar	108	24	Long's Peak	12	3	3.25	+1.75	Palisade Lake	8.71	Hartsel	0.71
Florida	81.8	+1.9	3 stations	105	5	Blountstown	57	30	6.99	+0.41	De Funiak Springs	15.83	Key West	0.14
Georgia	78.0	0.0	2 stations	108	[2] 4	Blue Ridge	50	15	5.68	+1.27	West Point	9.64	Cornelia	2.44
Idaho	61.7	+0.8	2 stations	104	25	Obsidian	25	2	1.09	−0.09	Prichard	3.74	Jerome	0.02
Illinois	68.1	−3.8	Palestine	102	30	2 stations	39	15	3.91	+0.01	Grand Chain	6.67	Salem	1.80
Indiana	66.8	−4.8	5 stations	99	30	2 stations	39	15	3.30	−0.53	Frankfort	6.45	Indianapolis	1.24
Iowa	66.4	−2.9	Inwood	101	28	Webster City	35	5	2.42	−2.11	Olin	7.05	Audubon	0.55
Kansas	71.2	−2.0	2 stations	106	24	Dresden	40	13	5.91	+1.89	Salina	12.39	Liberal	1.82
Kentucky	70.4	−3.5	3 stations	98	30	Bowling Green	42	16	4.13	+0.04	Frankfort	7.53	Munfordville	2.01
Louisiana	80.1	0.0	Dodson	100	[2] 1	Lake Providence	55	[2] 7	5.87	+1.06	Grand Coteau	9.68	Lake Providence	2.06
Maryland-Delaware	66.8	−4.1	2 stations	98	[2] 29	Oakland, Md.	31	6	3.54	−0.39	Ferry Landing, Md.	5.12	Coleman, Md.	1.97
Michigan	60.7	−3.2	2 stations	100	29	Sidnaw	22	1	1.99	−1.07	Painesdale	5.47	Midland	0.58
Minnesota	62.5	−1.8	Montevideo	102	28	2 stations	29	[2] 4	3.45	−0.75	Minneapolis	6.77	Tracy	1.13
Mississippi	78.8	0.0	Aberdeen	102	12	University	55	16	5.09	+1.05	Biloxi	9.69	Jackson	1.55
Missouri	70.3	−3.2	Rolla	99	29	Bethany	41	15	5.77	+1.10	Lebanon	11.61	Maryville	1.99
Montana	59.5	+0.1	Bridger	103	26	Conway's Ranch	24	1	1.91	−0.70	Hays	4.82	Brenner	0.33
Nebraska	66.8	−2.5	Atkinson	106	24	Gordon	29	14	3.66	−0.14	Benkelman	8.43	Plattsmouth	0.91
Nevada	66.7	+0.7	Logandale	113	23	Montello	25	1	0.30	−0.19	Orovada	1.36	7 stations	0.00
New England	60.5	−3.2	Turners Falls, Mass.	93	10	Van Buren, Me.	24	3	2.68	−0.62	Falmouth, Mass.	6.46	Woodsville, N. H.	0.91
New Jersey	65.4	−3.2	2 stations	97	[2] 10	Belleplain	31	2	3.16	−0.60	Belvidere	5.24	Tuckerton	1.46
New Mexico	67.8	−1.1	3 stations	105	[2] 9	Luna Ranger Station.	21	[2] 2	2.30	+0.78	Isidore	5.60	3 stations	T.
New York	61.6	−3.3	Troy	98	9	2 stations	27	[2] 2	2.24	−1.44	Roslyn	4.40	Auburn	0.78
North Carolina	71.4	−2.1	Caroleen	103	30	Mount Mitchell	35	16	4.93	0.00	Belhaven	8.86	Brewers	2.12
North Dakota	61.2	−1.6	Pembina	99	27	Hansboro	22	11	2.84	−0.66	Edgeley	6.69	Willow City	1.03
Ohio	64.6	−4.8	Fremont	100	30	Canfield	34	6	3.62	−0.18	Springfield (2)	6.17	Cleveland	1.63
Oklahoma	76.1	−0.4	3 stations	106	[2] 24	Goodwell	41	4	4.61	+0.74	Watts	14.32	Hooker	0.98
Oregon	61.3	+1.1	Echo	100	21	2 stations	26	[2] 2	1.48	+0.18	Cruzatte	4.91	Merrill	0.11
Pennsylvania	63.8	−4.4	Lewisburg	90	29	West Bingham	25	16	3.72	−0.38	Palmerton	6.78	Erie	1.59
South Carolina	74.9	−2.6	Winnsboro	104	30	2 stations	48	16	5.67	+0.86	Yemassee	11.62	Lockhart	2.00
South Dakota	64.2	−1.8	2 stations	104	[2] 27	Castlewood	31	5	2.79	−0.72	Harveys Ranch	7.88	Kennebec	0.90
Tennessee	73.2	−1.4	Halls	100	30	2 stations	44	16	4.94	+0.69	Parksville	10.13	Florence	2.95
Texas	79.5	−0.6	2 stations	108	[2] 3	Clint	38	11	4.60	+1.33	Liberty	11.78	2 stations	0.00
Utah	64.6	+0.3	2 stations	107	24	Woodruff	15	1	1.10	+0.49	Price	3.69	Leeds (near)	T.
Virginia	68.2	−3.7	Chatham	102	30	Burkes Garden	36	[2] 16	3.23	−1.36	Williamsburg	6.24	Hawfield	1.35
Washington	62.0	+1.6	Lowden	100	21	Cascade Tunnel	30	1	1.15	−0.30	Colville	3.76	4 stations	T.
West Virginia	65.7	−3.6	Wheeling	99	30	Bayard	29	6	4.08	−0.33	Bayard	9.93	Organ Cave	2.10
Wisconsin	61.6	−2.8	Blair	99	28	2 stations	21	1	2.79	−1.18	Sheboygan	6.31	High Falls	1.23
Wyoming	58.7	−0.7	Wheatland	102	26	2 stations	21	[2] 1	2.43	+0.76	Hunter's Station	5.03	Border	0.46
Alaska (May)	42.7	−0.2	Skagway	79	19	Igloo	−12	2	2.91	−0.66	Chignik	12.80	McKinley Park	T.
Hawaii	74.2	+1.2	2 stations	93	[2] 6	Volcano Observatory	46	10	3.87	−0.65	Olokele (Mauka)	22.00	7 stations	0.00
Porto Rico														

[1] For description of tables and charts, see REVIEW, January, 1927, p. 43.

[2] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau Stations, June, 1927*

District and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0–10	In.	In.
New England							61.2	−2.3										70	2.86	−0.5											5.0		
Eastport	76	67	85	29.86	29.94	+.01	53.9	−1.2	76	9	63	39	3	45	33	50	46	76	4.22	+1.0	11	6,424	s.	39	s.	5	6	13	11	6.5	0.0	0.0
Greenville, Me	1,070	6	----	28.80	29.96	----	56.2	----	84	23	69	30	4	44	38	----	----	----	1.57	----	11	4,632	nw.	35	----	6	13	7	10	----	0.0	0.0
Portland, Me	103	82	117	29.86	29.98	+.03	61.1	−1.4	87	23	70	44	3	52	27	55	49	66	2.68	−0.7	7	6,007	s.	34	s.	25	17	7	6	3.9	0.0	0.0
Concord	289	70	79	29.67	29.97	+.01	60.8	−2.1	90	10	73	34	2	48	35	----	----	----	2.30	−1.0	9	4,084	nw.	28	nw.	27	10	14	6	4.9	0.0	0.0
Burlington	403	11	48	29.54	29.97	+.01	60.2	−5.5	86	10	71	38	2	50	30	----	----	----	1.58	−1.7	15	6,138	s.	54	s.	25	6	14	10	6.0	0.0	0.0
Northfield	876	12	60	----	29.98	+.02	56.8	−4.5	84	10	70	31	3	44	38	----	----	69	1.08	−2.2	12	5,116	s.	34	s.	25	2	19	9	----	0.0	0.0
Boston	125	115	188	29.84	29.98	+.02	65.0	−1.5	90	10	74	50	6	57	27	57	50	62	2.43	−0.6	11	6,642	sw.	29	nw.	27	13	11	6	4.9	0.0	0.0
Nantucket	12	14	90	29.96	29.97	−.01	60.2	−0.8	75	12	67	45	4	54	22	55	52	79	2.76	+0.4	10	11,128	sw.	54	ne.	20	9	13	8	5.4	0.0	0.0
Block Island	26	11	46	29.94	29.97	.00	60.7	−1.1	77	23	66	50	4	56	17	56	54	82	2.96	+0.1	12	10,808	sw.	56	nw.	23	14	7	9	4.6	0.0	0.0
Providence	160	215	251	29.81	29.98	+.01	64.4	−3.9	90	23	74	46	4	55	29	56	50	62	3.04	−0.1	13	8,678	nw.	52	nw.	5	12	12	6	4.6	0.0	0.0
Hartford	159	122	----	29.81	29.98	+.01	64.8	−2.3	89	10	74	47	4	55	28	----	----	----	2.60	−1.1	10	----	nw.	----	----	----	14	9	7	4.3	0.0	0.0
New Haven	106	74	153	29.88	29.99	+.02	65.2	−1.4	90	23	74	47	4	56	28	57	52	66	3.06	−0.1	11	6,416	sw	31	w.	23	10	14	6	4.9	0.0	0.0
Middle Atlantic States							66.8	−3.5										70	3.33	−0.4										5.3		
Albany	97	102	115	29.88	29.98	+.01	64.4	−3.6	92	10	74	45	3	55	29	59	54	70	2.70	−1.1	10	5,056	s.	34	s.	25	15	11	4	4.2	0.0	0.0
Binghamton	871	10	84	29.09	30.02	+.05	62.0	−3.6	91	29	74	38	2	50	32	----	----	----	2.58	−1.0	9	3,876	nw.	27	se.	4	7	13	10	5.7	0.0	0.0
New York	314	414	454	29.67	30.00	+.02	65.8	−3.0	86	10	74	49	6	58	23	58	52	65	3.13	−0.1	10	10,844	nw.	62	nw.	5	6	16	8	5.9	0.0	0.0
Harrisburg	374	94	104	29.62	30.02	+.03	66.3	−4.0	93	29	76	46	2	57	32	59	53	64	3.89	+0.3	9	4,710	nw.	31	s.	25	7	12	11	6.0	0.0	0.0
Philadelphia	114	123	190	29.89	30.01	+.03	68.6	−2.8	94	29	78	51	6	60	29	62	58	73	3.48	+0.2	8	6,064	sw.	28	n.	26	7	12	11	5.8	0.0	0.0
Reading	325	81	98	29.66	30.00	----	66.8	----	94	29	76	48	6	57	31	59	53	64	4.39	+0.7	10	4,356	w.	33	se.	4	13	10	7	4.8	0.0	0.0
Scranton	805	111	119	29.16	30.01	+.03	63.2	−4.6	92	29	74	39	2	52	34	56	51	66	4.07	+0.5	10	4,754	nw.	30	s.	25	13	7	10	4.9	0.0	0.0
Atlantic City	52	37	172	29.94	30.00	+.02	65.0	−1.6	92	29	72	48	2	58	26	60	56	73	2.24	−0.8	7	11,585	s.	42	ne.	14	10	14	6	4.8	0.0	0.0
Cape May	17	13	49	----	----	----	66.0	−1.7	91	29	74	47	2	58	25	----	----	----	3.22	----	11	----	sw.	----	----	----	----	----	----	----	0.0	0.0
Sandy Hook	22	10	55	29.97	29.99	----	65.6	----	85	10	73	51	6	58	23	59	55	74	2.14	----	11	9,184	sw.	50	nw.	5	10	12	8	5.0	0.0	0.0
Trenton	190	159	183	29.80	30.00	----	66.4	----	91	29	76	47	2	56	28	59	54	68	3.30	−0.2	11	7,278	sw.	42	w.	5	10	12	8	5.4	0.0	0.0
Baltimore	123	100	215	29.88	30.00	+.01	69.3	−3.4	98	29	78	52	6	60	34	61	55	63	2.96	−0.9	10	7,119	sw.	36	nw.	5	10	13	7	5.5	0.0	0.0
Washington	112	62	85	29.88	30.00	.00	68.6	−3.6	95	29	78	50	6	59	32	62	58	71	4.01	−0.2	11	4,304	s.	27	nw.	5	10	13	7	5.3	0.0	0.0
Cape Henry	18	8	54	29.98	30.01	----	68.6	----	94	14	76	51	17	62	31	64	61	77	4.21	−0.2	9	8,735	ne.	52	nw.	14	8	15	7	5.6	0.0	0.0
Lynchburg	681	153	188	29.29	30.02	+.01	70.4	−4.2	100	30	81	50	2	60	33	63	58	69	1.87	−2.0	10	4,444	w.	46	nw.	14	9	15	6	5.2	0.0	0.0
Norfolk	91	170	205	29.93	30.03	+.03	70.1	−4.3	91	23	79	53	7	62	29	63	60	74	4.68	+0.4	12	8,111	s.	52	nw.	14	5	17	8	5.8	0.0	0.0
Richmond	144	11	52	29.88	30.02	+.01	69.4	−4.7	95	29	80	50	2	59	34	63	59	72	3.12	−0.4	5	4,901	ne.	39	n.	14	10	12	8	5.0	0.0	0.0
Wytheville	2,304	49	55	27.69	30.01	.00	65.4	−3.3	88	30	75	46	6	56	36	60	57	77	2.67	−1.4	12	3,607	w.	26	w.	14	8	14	8	5.7	0.0	0.0
South Atlantic States							73.3	−1.2										79	5.19	+0.3										6.5		
Asheville	2,253	70	84	27.72	30.01	.00	68.5	−0.2	89	30	77	52	15	60	27	62	60	79	4.47	+0.3	15	5,135	se.	27	s.	13	4	16	10	6.4	0.0	0.0
Charlotte	779	55	62	29.20	30.02	+.01	73.3	−2.2	98	30	83	53	16	64	30	66	62	75	3.41	−1.0	13	2,618	ne.	33	sw.	14	3	14	13	6.9	0.0	0.0
Hatteras	11	11	50	29.99	30.00	−.01	71.6	−4.0	85	24	78	60	15	66	20	67	64	79	5.45	+1.1	14	9,365	ne.	60	w.	14	14	9	7	4.9	0.0	0.0
Raleigh	376	103	110	29.62	30.02	+.01	72.3	−3.4	97	30	81	55	15	63	30	66	63	79	4.28	−0.4	12	5,282	ne.	39	nw	14	4	14	12	6.3	0.0	0.0
Wilmington	78	81	91	29.94	30.03	+.02	75.3	−1.5	94	11	84	58	18	67	26	69	67	81	4.33	−1.3	13	5,262	sw.	24	w.	14	4	16	10	6.4	0.0	0.0
Charleston	48	11	92	29.96	30.02	+.01	78.8	−0.1	98	5	86	63	16	72	25	73	71	81	4.10	−1.3	13	7,145	sw.	44	e.	6	6	7	17	6.8	0.0	0.0
Columbia, S. C	351	41	57	29.65	30.02	+.01	76.4	−1.7	101	30	86	58	15	67	30	69	66	78	4.10	−0.1	14	4,030	ne.	27	sw.	14	7	5	18	6.8	0.0	0.0
Due West	711	10	55	29.28	30.04	----	73.8	----	99	30	83	55	18	64	31	----	----	----	4.89	----	15	5,457	sw.	48	nw.	14	4	8	18	7.3	0.0	0.0
Greenville, S. C	1,039	139	146	28.94	30.01	----	72.6	−1.5	99	30	81	56	18	64	26	66	64	79	4.95	----	17	5,450	ne.	35	sw.	14	4	11	15	6.9	0.0	0.0
Augusta	182	62	77	29.82	30.01	.00	78.0	−0.7	99	30	87	60	18	69	31	71	69	80	6.51	+2.0	12	3,135	nw.	26	w.	26	2	14	14	7.0	0.0	0.0
Savannah	65	150	194	29.95	30.02	+.01	79.8	+0.8	100	4	89	62	16	71	28	73	71	81	7.68	+1.6	17	7,287	w.	48	w.	7	10	6	14	6.1	0.0	0.0
Jacksonville	43	209	245	29.97	30.02	+.01	81.2	+1.3	99	4	90	68	8	72	26	73	70	78	7.56	+2.0	18	6,747	sw.	40	w.	22	8	10	12	5.7	0.0	0.0
Florida Peninsula							83.3	+2.6										74	2.48	−4.1										5.6		
Key West	22	10	64	30.00	30.02	+.03	84.9	+3.0	92	14	90	75	1	80	13	76	74	73	0.14	−4.1	2	6,344	se.	22	se.	28	13	12	5	4.5	0.0	0.0
Miami	25	71	79	30.02	30.05	----	82.3	+2.3	89	18	87	71	19	78	17	75	72	72	2.40	−4.7	5	4,511	se.	22	e.	6	9	14	7	4.8	0.0	0.0
Tampa	35	79	87	30.00	30.03	+.02	82.7	+2.5	95	22	91	67	28	74	26	75	72	77	4.91	−3.4	13	3,841	w.	34	ne.	28	5	19	6	5.6	0.0	0.0
Titusville	44	5	----	29.99	30.04	----	82.2	----	100	3	93	66	30	71	33	----	----	----	5.74	----	13	----	s.	----	----	----	----	----	----	----	----	----
East Gulf States							78.6	0.0										78	5.45	+0.9										6.4		
Atlanta	1,173	190	216	28.81	30.03	+.02	74.2	−1.8	95	30	82	58	16	66	23	67	64	77	3.02	−0.9	17	6,441	w.	40	w.	13	4	8	18	6.9	0.0	0.0
Macon	370	78	87	29.62	30.01	.00	78.0	−0.9	98	4	88	60	16	68	30	70	67	74	4.96	+1.4	17	3,659	nw.	30	nw.	19	3	16	11	6.4	0.0	0.0
Thomasville	273	49	58	29.72	30.01	+.01	80.8	+1.3	101	5	91	68	8	71	29	72	70	79	5.62	+0.9	17	2,952	sw.	26	sw.	14	5	10	15	7.0	0.0	0.0
Apalachicola	36	42	49	29.97	30.01	----	80.9	----	96	1	87	70	7	75	20	75	74	81	5.85	----	13	5,049	w.	29	n.	19	14	8	8	4.7	0.0	0.0
Pensacola	56	149	185	29.95	30.00	+.01	79.7	+0.4	91	5	85	66	24	74	17	75	73	81	9.40	+4.5	12	8,217	s.	41	s.	7	5	14	11	6.0	0.0	0.0
Anniston	741	9	57	29.25	30.03	+.03	75.8	+0.8	95	3	85	60	16	66	29	----	----	----	5.30	+1.4	18	2,618	s.	26	sw.	19	4	15	11	6.2	0.0	0.0
Birmingham	700	11	48	29.27	30.02	+.03	76.8	−1.1	93	30	85	62	16	68	23	70	68	79	5.45	+1.6	17	3,840	s.	32	w.	19	5	12	13	6.8	0.0	0.0
Mobile	57	125	161	29.94	30.00	+.01	80.6	+0.3	95	5	88	67	25	73	21	74	72	78	5.72	−0.2	12	5,962	sw.	43	n.	26	2	15	13	6.8	0.0	0.0
Montgomery	223	100	112	29.77	30.02	+.02	79.8	+0.2	96	3	88	66	16	71	23	72	69	76	3.47	−0.7	15	4,259	sw.	34	n.	19	6	14	10	6.4	0.0	0.0
Corinth	469	6	----	----	----	----	77.0	----	96	30	86	58	16	68	24	----	----	----	7.62	----	15	----	s.	----	----	----	2	26	2	----	0.0	0.0
Meridian	375	87	95	29.60	29.99	+.01	78.4	+0.3	94	4	87	63	16	70	24	72	69	77	5.09	+0.5	12	3,858	sw.	28	ne.	26	3	14	13	6.7	0.0	0.0
Vicksburg	247	65	73	29.73	30.01	+.04	78.2	−0.8	92	26	85	65	16	71	19	72	70	78	4.13	−0.4	13	4,045	sw.	33	nw.	4	5	13	12	6.0	0.0	0.0
New Orleans	53	78	84	29.94	29.99	+.01	82.0	+1.4	93	26	88	70	10	76	19	75	73	79	7.78	+1.6	21	3,550	sw.	15	n.	25	3	15	12	6.6	0.0	0.0
West Gulf States							78.9	−0.8										77	5.06	+1.4										5.5		
Shreveport	249	77	93	29.71	29.97	+.01	79.0	−1.7	95	26	88	64	7	70	22	72	70	80	5.76	+2.2	11	4,312	s.	30	s.	20	9	12	9	5.3	0.0	0.0
Bentonville	1,308	11	44	----	----	----	72.2	−1.9	91	25	82	53	15	63	30	----	----	----	7.47	----	12	3,396	s.	24	s.	3	14	7	9	----	0.0	0.0
Fort Smith	457	79	94	29.47	29.94	.00	76.6	−0.9	98	26	86	61	15	67	27	69	66	73	3.15	−0.8	10	5,114	e.	45	sw.	20	12	9	9	5.0	0.0	0.0
Little Rock	357	136	144	29.60	29.97	+.01	76.2	−1.2	92	12	85	57	7	68	24	70	67	75	5.71	+1.6	11	5,663	s.	42	w.	20	11	11	8	5.2	0.0	0.0
Austin	605	136	148	29.32	29.94	----	79.8	−1.4	96	2	89	61	15	70	25	----	----	----	5.03	+2.4	9	5,234	se.	44	n.	13	9	8	13	5.7	0.0	0.0
Brownsville	57	53	61	29.82	29.88	----	82.2	−0.2	94	9	89	69	9	76	25	76	74	83	6.51	----	11	6,053	s.	28	n.	7	8	16	6	5.1	0.0	0.0
Corpus Christi	20	11	78	29.91	29.93	+.02	82.2	+1.2	91	27	88	68	6	77	17	76	74	80	5.70	+3.0	11	10,432	se.	45	ne.	14	4	12	14	6.2	0.0	0.0
Dallas	512	220	227	29.41	29.94	----	78.8	----	97	26	88	62	15	70	24	----	----	----	2.61	----	8	8,510	se.	61	n.	21	14	11	5	4.2	0.0	0.0
Fort Worth	670	106	114	29.23	29.93	+.01	80.1	+0.2	102	26	90	64	15	70	28	70	67	71	3.33	+0.2	9	7,183	s.	32	se.	29	10	15	5	5.0	0.0	0.0
Galveston	54	106	114	29.92	29.98	+.03	80.8	+0.1	90	26	85	69	14	76	17	75	73	81	3.09	−1.7	12	7,811	s.	39	nw.	14	6	15	9	5.4	0.0	0.0
Groesbeck	461	11	56	29.47	29.94	----	78.2	----	93	27	87	60	15	69	21	----	----	----	5.16	----	9	6,207	se.	57	s.	29	5	15	10	6.4	0.0	0.0
Houston	138	292	314	29.82	29.97	----	80.1	−1.3	95	25	88	66	21	72	23	----	----	----	5.98	+1.7	15	7,935	se.	44	n.	21	7	15	8	5.5	0.0	0.0
Palestine	510	64	72	29.44	29.96	+.02	78.2	−0.8	94	26	87	63	15	69	23	71	68	77	5.82	+1.8	11	4,806	s.	29	se.	29	4	13	13	6.5	0.0	0.0
Port Arthur	34	58	66	29.92	29.96	----	81.1	----	94	26	87	68	7	75	18	----	----	----	7.84	----	13	5,679	s.	25	nw.	14	9	11	10	5.6	0.0	0.0
San Antonio	693	119	132	29.21	29.92	+.02	80.0	−1.0	96	1	90	63	6	70	30	72	69	75	7.91	+4.8	12	5,510	s.	44	w.	4	7	12	11	6.0	0.0	0.0
Taylor	583	55	63	29.36	29.97	+.05	78.9	−1.1	95	2	88	60	15	70	25	----	----	----	4.15	+0.6	9	5,682	s.	41	e.	29	7	19	4	5.4	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, June, 1927*—Continued

Districts and stations	Elevation or instruments: Barometer above sea level	Elevation or instruments: Thermometer above ground	Elevation or instruments: Anemometer above ground	Pressure: Stations, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
							69.0	−3.8										72	3.39	−0.8							5.8					
Ohio Valley and Tennessee																																
Chattanooga	762	189	213	29.20	30.00	.00	73.7	−1.7	93	30	82	58	16	66	23	67	64	74	4.39	+0.1	12	4,916	sw.	38	sw.	21	5	12	13	6.6	0.0	0.0
Knoxville	995	102	111	28.96	30.00	.00	73.0	−1.0	93	30	82	57	8	64	26	66	64	77	3.18	−1.0	15	4,085	sw.	36	sw.	21	5	12	13	6.4	0.0	0.0
Memphis	399	76	97	29.55	29.97	.00	75.9	−1.7	93	28	83	58	7	69	25	69	66	73	4.16	−0.2	12	5,114	sw.	44	nw.	19	7	8	15	6.3	0.0	0.0
Nashville	546	168	191	29.44	30.01	+.02	73.4	−2.2	93	30	82	54	7	65	23	67	63	74	4.49	+0.1	10	5,642	sw.	30	nw.	13	2	17	11	6.5	0.0	0.0
Lexington	989	193	230	28.96	30.02	+.02	68.8	−3.4	92	30	77	50	6	60	28				2.14	−1.8	10	8,033	se.	40	sw.	21	13	8	9	4.8	0.0	0.0
Louisville	525	188	234	29.44	30.02	+.04	69.6	−5.1	93	30	78	51	7	61	28	63	59	72	4.00	−0.2	13	6,701	ne.	40	w.	4	8	12	10	5.7	0.0	0.0
Evansville	431	76	116	29.56	30.02	+.05	71.5	−3.6	95	30	80	52	7	63	30	65	61	72	3.04	−1.1	11	5,550	s.	30	w.	4	10	12	8	5.1	0.0	0.0
Indianapolis	822	194	230	29.13	30.01	+.04	67.0	−4.6	94	30	76	47	6	58	28	59	54	66	1.24	−3.1	9	7,925	sw.	30	n.	25	6	18	6	5.5	0.0	0.0
Royal Center	736	11	55	29.22	30.01	------	64.0	------	94	30	74	42	15	54	32	------	------	------	2.07	------	8	6,756	n.	27	nw.	4	8	13	9	5.6	0.0	0.0
Terre Haute	575	96	129	29.38	29.99	------	68.3	------	96	30	77	49	6	59	28	62	58	71	2.43	------	9	6,491	s.	27	nw.	4	9	11	10	5.2	0.0	0.0
Cincinnati	627	11	51	29.34	30.02	+.03	67.2	−4.0	95	30	78	45	6	57	36	61	58	72	4.22	+0.2	12	4,603	ne.	27	sw.	4	9	13	8	5.2	0.0	0.0
Columbus	822	179	222	29.16	30.02	+.03	65.6	−5.3	93	30	74	49	16	57	27	60	57	74	3.63	+0.1	10	6,537	e.	43	w.	4	7	19	4	5.2	0.0	0.0
Dayton	899	137	173	29.07	30.01	------	66.5	−4.9	95	30	76	47	6	57	35	60	55	67	2.51	−1.4	9	5,932	ne.	36	w.	12	2	13	15	7.1	0.0	0.0
Elkins	1,947	59	67	28.02	30.03	+.03	62.0	−4.9	86	30	73	36	6	51	36	57	54	79	5.23	+0.2	17	3,351	nw	26	w.	4	11	7	12	5.6	0.0	0.0
Parkersburg	637	77	82	29.39	30.04	+.04	66.9	−4.5	94	30	77	46	6	56	36	59	55	67	2.52	−2.1	11	3,622	nw.	29	nw.	4	5	11	14	6.9	0.0	0.0
Pittsburgh	842	353	410	29.13	30.02	+.03	64.6	−5.1	90	30	74	45	6	56	29	58	53	68	2.77	−1.1	7	7,420	n.	48	nw.	4	5	11	14	7.6	0.0	0.0
																														4.8		
							62.6	−4.2										68	1.86	−1.7												
Lower Lake Region																																
Buffalo	767	247	280	29.17	30.00	+.03	59.6	−4.8	83	21	66	43	6	53	24	55	50	72	2.04	−0.8	8	10,939	sw.	66	w.	25	8	16	6	5.1	0.0	0.0
Canton	448	10	61	29.50	29.97	------	60.7	−5.1	86	29	71	39	2	50	31	------	------	------	1.54	−1.9	12	6,336	w.	38	w.	10	16	11	3	3.4	0.0	0.0
Oswego	335	76	91	------	29.98	+.01	59.6	−5.2	83	10	68	42	6	51	32	------	------	67	1.42	−2.0	10	6,290	sw.	31	se.	4	10	13	7	----	0.0	0.0
Rochester	523	86	102	29.43	30.00	+.03	63.0	−3.1	92	30	72	42	6	54	28	56	49	61	1.25	−1.9	7	6,498	w.	33	sw.	10	14	8	8	4.9	0.0	0.0
Syracuse	597	97	113	29.37	30.02	+.05	62.2	−4.7	86	29	71	44	6	55	26	59	55	76	1.21	−2.7	9	4,985	nw.	43	s.	4	10	12	8	5.3	0.0	0.0
Erie	714	130	166	29.25	30.01	+.03	62.6	−3.6	89	30	70	44	6	55	26	57	52	66	1.59	−2.2	7	7,737	nw.	55	se.	4	13	13	4	4.4	0.0	0.0
Cleveland	762	190	201	29.20	30.02	+.04	63.2	−3.9	89	30	70	45	1	56	33	------	------	------	1.63	−2.0	10	8,506	n.	42	n.	25	9	11	10	5.5	0.0	0.0
Sandusky	629	5	67	29.34	30.02	+.04	64.8	−4.0	94	30	74	47	2	56	26	58	54	69	2.62	−1.2	10	5,802	sw.	29	nw.	5	8	16	6	5.3	0.0	0.0
Toledo	628	208	243	29.34	30.02	+.05	64.6	−4.1	94	30	73	44	1	56	29	58	53	67	2.95	−0.4	7	8,820	sw.	38	w.	4	16	10	4	4.0	0.0	0.0
Fort Wayne	856	113	124	29.09	30.01	------	64.6	−3.9	94	30	74	47	6	55	29	58	53	67	2.69	------	6	5,896	sw.	31	s.	4	15	10	5	4.2	0.0	0.0
Detroit	730	218	258	29.23	30.02	+.05	63.6	−3.8	92	30	72	47	5	56	26	56	50	64	2.30	−1.6	6	7,126	sw.	31	sw.	25	5	18	7	5.9	0.0	0.0
																		69	2.11	−1.3										4.8		
							60.0	−2.7																								
Upper Lake Region																																
Alpena	609	13	92	29.33	29.99	+.03	58.2	−2.2	96	29	69	36	1	48	32	53	47	68	1.56	−2.0	4	7,750	se.	37	nw	5	14	11	5	4.6	0.0	0.0
Escanaba	612	54	60	29.30	29.96	+.02	56.8	−3.9	80	30	65	32	1	48	25	52	47	71	1.22	−2.4	6	7,351	s.	40	s.	24	11	13	6	4.8	0.0	0.0
Grand Haven	632	54	89	29.31	29.98	+.02	60.2	−3.5	86	30	69	42	1	52	27	55	50	68	2.01	−0.5	7	7,725	s.	33	s.	24	12	15	3	4.1	0.0	0.0
Grand Rapids	707	70	87	29.24	30.00	+.02	64.2	−3.6	93	30	75	44	5	54	30	56	50	61	1.45	−1.1	6	4,060	nw.	23	nw	25	5	16	9	5.9	0.0	0.0
Houghton	668	62	99	29.22	29.94	.00	58.2	−1.8	96	30	68	36	1	48	37	------	------	------	4.15	+0.7	11	6,418	e.	41	sw.	28	10	9	11	5.3	0.0	0.0
Lansing	878	11	62	29.07	30.00	------	62.4	−4.0	94	30	74	39	6	51	34	57	53	71	1.49	−1.9	9	3,616	sw.	22	sw.	5	12	13	5	4.5	0.0	0.0
Ludington	637	60	66	29.29	29.99	------	57.4	------	82	30	65	39	1	50	24	54	50	74	1.85	------	6	7,382	s.	38	s.	9	14	13	3	3.5	0.0	0.0
Marquette	734	77	111	29.16	29.98	+.02	57.7	−1.2	99	29	67	35	1	48	37	53	49	74	1.81	−1.7	10	7,158	s.	44	sw.	28	8	9	13	6.3	0.0	0.0
Port Huron	638	70	120	29.31	30.00	+.03	60.6	−3.6	95	30	71	40	1	50	32	55	51	70	2.22	−1.0	8	7,150	sw.	35	nw.	4	11	16	3	4.0	0.0	0.0
Sault Sainte Marie	614	11	52	29.29	29.98	+.02	55.6	−3.0	93	30	66	35	1	45	34	50	46	73	1.27	−1.5	7	5,723	nw.	30	nw.	11	11	15	4	4.8	0.0	0.0
Chicago	673	7	131	29.28	30.00	+.04	64.8	−2.5	94	29	73	47	24	57	29	57	53	69	2.55	−1.1	12	7,705	ne.	34	sw.	22	10	13	7	4.7	0.0	0.0
Green Bay	617	109	141	29.30	29.96	+.01	62.0	−2.9	91	30	72	41	1	52	26	56	50	67	1.96	−1.6	8	7,591	s.	44	s.	9	10	14	7	5.1	0.0	0.0
Milwaukee	681	125	221	29.26	29.99	+.04	62.0	−1.7	94	30	71	45	1	53	29	55	48	61	1.68	−2.0	6	9,020	e.	41	sw.	9	12	12	6	4.6	0.0	0.0
Duluth	1,133	5	47	28.73	29.94	+.02	56.6	−0.6	89	28	67	35	1	46	33	52	48	74	4.06	−0.5	10	7,052	ne.	43	nw.	7	11	14	5	5.1	0.0	0.0
																		67	3.05	−0.6										5.7		
							62.2	−1.2																								
North Dakota																																
Moorhead	940	50	58	28.89	29.90	.00	62.7	−1.7	92	27	74	36	5	52	34	56	51	68	4.28	+0.2	12	5,701	s.	27	w.	28	6	10	14	6.4	0.0	0.0
Bismarck	1,674	8	57	28.14	29.90	+.03	62.3	−1.4	89	27	73	40	12	52	38	55	50	68	2.72	−0.8	13	6,376	s.	72	w.	30	5	17	8	5.6	0.0	0.0
Devils Lake	1,478	11	44	28.34	29.89	+.01	61.6	−1.0	92	27	73	36	11	50	31	55	49	67	2.47	−1.1	10	6,154	s.	37	nw.	7	10	13	7	5.0	0.0	0.0
Ellendale	1,457	10	56	28.37	29.92	------	62.0	------	93	27	72	38	5	52	29	------	------	------	3.64	------	15	9,047	s.	57	sw.	29	3	14	13	6.5	0.0	0.0
Grand Forks	833	12	67	------	------	------	62.5	------	90	27	73	37	5	52	36	56	------	------	3.58	------	11	------	n.	42	n.	9	9	16	5	5.7	0.0	0.0
Williston	1,878	41	48	27.93	29.88	+0.2	62.0	−0.7	89	26	72	42	4	52	30	54	49	64	2.74	−0.8	14	4,772	se.	37	nw.	24	9	47	4	4.8	0.0	0.0
																		69	3.70	−0.6										5.1		
							67.2	−3.3																								
Upper Mississippi Valley																																
Minneapolis	918	102	208	28.93	29.90	------	64.9	−2.6	96	28	74	41	5	56	30	------	------	------	6.77	+2.8	10	7,970	s.	42	n.	22	7	12	11	6.0	0.0	0.0
St. Paul	837	236	261	29.03	29.93	+.01	63.8	−3.3	94	28	73	40	5	55	30	------	------	------	3.98	−0.4	8	8,742	se.	50	nw.	9	10	14	6	5.0	0.0	0.0
La Crosse	714	11	43	29.19	29.95	+.02	64.8	−3.5	94	30	75	42	15	55	29	58	53	68	2.46	−2.0	8	3,184	se.	24	se.	24	9	11	10	5.3	0.0	0.0
Madison	974	70	78	28.96	29.99	+.05	63.6	−3.6	92	30	72	46	5	55	28	56	51	66	2.17	−1.9	8	5,681	sw.	31	s.	24	8	13	9	5.1	0.0	0.0
Wausau	1,247	4	----	28.65	29.97	------	60.6	------	93	30	72	36	1	49	31	------	------	------	4.43	------	11	------	s.	----	----	24	12	9	9	4.5	0.0	0.0
Charles City	1,015	10	49	28.90	29.97	+.06	64.0	−2.5	94	30	74	41	5	54	32	58	53	70	1.48	−3.6	9	4,903	se.	32	sw.	24	12	9	9	4.8	0.0	0.0
Davenport	606	71	79	29.32	29.98	+.04	67.4	−3.1	95	30	76	47	1	58	30	60	55	66	2.83	−1.3	11	5,178	e.	25	s.	9	13	8	9	4.8	0.0	0.0
Des Moines	861	84	97	29.06	29.96	+.03	67.8	−2.8	94	29	77	47	5	58	28	60	55	66	0.69	−4.3	8	5,898	sw.	40	sw.	24	9	15	6	5.6	0.0	0.0
Dubuque	700	81	96	29.22	29.96	+.03	66.0	−3.4	93	30	75	47	15	57	28	58	53	64	2.31	−2.2	8	4,599	s.	24	s.	24	9	15	6	5.0	0.0	0.0
Keokuk	614	64	78	29.32	29.98	+.04	68.2	−4.3	93	30	76	51	5	60	25	62	58	70	6.61	+2.3	11	4,720	s.	28	nw.	22	11	10	9	5.0	0.0	0.0
Cairo	258	87	93	29.60	29.98	+.01	73.1	−3.2	94	30	80	57	7	66	26	68	65	78	5.89	+1.6	11	5,484	n.	36	n.	12	10	7	13	5.8	0.0	0.0
Peoria	609	11	45	29.35	30.01	+.06	67.2	−3.7	94	30	77	47	15	57	30	61	56	70	5.71	+1.4	9	4,091	s.	30	n.	3	14	11	5	4.0	0.0	0.0
Springfield, Ill	636	10	91	29.31	29.98	+.03	68.9	−3.3	96	30	78	49	15	60	31	62	57	69	3.50	−0.8	8	5,704	s.	30	n.	11	15	5	10	4.6	0.0	0.0
Hannibal	534	74	109	29.41	29.98	+.03	69.3	−3.2	92	30	77	52	16	61	26	------	------	------	4.88	+1.4	10	5,924	sw.	48	e.	3	13	9	8	4.6	0.0	0.0
St. Louis	568	265	303	29.38	29.98	+.03	71.2	−3.6	94	30	79	54	6	63	26	63	59	69	2.59	−1.9	10	7,705	s.	35	s.	20	10	10	10	5.4	0.0	0.0
																		67	4.30	−0.1										4.6		
							68.7	−2.1																								
Missouri Valley																																
Columbia, Mo	784	11	84	29.15	29.97	+.02	69.5	−3.3	92	30	78	52	13	61	27	------	------	------	6.11	+1.7	9	5,021	s.	40	nw.	3	13	7	10	5.1	0.0	0.0
Kansas City	963	161	181	28.94	29.95	+.03	70.4	−3.2	91	25	78	52	13	63	24	63	59	70	5.75	+1.1	11	7,366	s.	43	nw.	11	15	6	9	4.3	0.0	0.0
St. Joseph	967	11	49	28.92	29.94	------	71.2	------	93	29	80	51	15	62	26	62	58	68	5.00	------	11	6,621	s.	45	w.	11	19	5	6	3.7	0.0	0.0
Springfield, Mo	1,324	98	104	28.55	29.94	−.01	70.2	−2.3	89	11	78	49	15	62	29	------	------	------	5.95	+0.8	8	5,906	se.	35	s.	3	16	13	1	2.9	0.0	0.0
Iola	994	11	50	28.92	29.94	+.01	71.4	−2.7	93	11	81	49	13	62	27	------	------	------	6.72	+1.3	11	6,379	s.	30	e.	9	14	6	10	4.7	0.0	0.0
Topeka	987	92	107	------	------	------	70.7	−2.7	92	11	80	49	13	62	27	------	------	------	8.19	+3.4	12	6,887	se.	36	n.	12	6	11	12	4.4	0.0	0.0
Lincoln	1,189	11	84	28.69	29.93	+.03	69.6	−1.8	97	27	80	48	15	59	30	61	56	66	3.43	−0.9	10	7,701	s.	36	n.	11	12	10	8	5.3	0.0	0.0
Omaha	1,105	115	122	28.78	29.94	+.03	70.4	−1.2	97	28	80	49	5	60	28	61	55	62	1.27	−3.8	9	5,697	s.	56	sw.	29	8	14	8	5.3	0.0	0.0
Valentine	2,598	47	54	27.26	29.94	+.08	64.8	−2.1	100	27	76	41	14	54	37	56	51	66	2.97	−0.8	11	7,068	s.	48	sw.	30	14	7	9	4.8	0.0	0.0
Sioux City	1,135	94	164	28.75	29.92	+.04	67.9	−1.6	98	28	78	45	5	55	33	58	52	63	3.52	−0.4	11	9,090	s.	38	nw.	9	13	11	6	4.5	0.0	0.0
Huron	1,306	59	74	28.54	29.92	+.04	65.8	−0.4	102	27	77	41	5	55	33	------	------	64	1.23	−2.6	11	6,737	s.	50	sw.	28	11	8	11	----	0.0	0.0
Pierre	1,572	70	75	------	29.92	+.05	66.4	−2.1	100	27	77	46	5	56	34	------	------	------	2.62	−0.5	13	6,367	nw.	34	nw.	20	12	8	10	4.9	0.0	0.0
Yankton	1,233	49	57	28.62	29.92	+.03	67.6	−1.3	102	28	78	45	12	57	31	------	------	------	2.89	−0.4	9	5,793	nw.									

TABLE 1.—*Climatological data for Weather Bureau stations, June, 1927*—Continued

Districts and stations	Elevation or instruments: Barometer above sea level	Elevation or instruments: Thermometer above ground	Elevation or instruments: Anemometer above ground	Pressure: Stations, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
Northern Slope							60.9	−0.6										64	2.62	−0.3										5.5		
Billings	3,140	5					63.6		102	26	77	37	2	50	42				3.34		9		nw.				10	11	9		0.0	0.0
Havre	2,505	11	44	27.30	29.90	+.05	61.8	−0.2	86	25	73	39	4	50	40	53	47	64	1.05	−1.8	12	4,873	e.	36	sw.	24	9	15	6	5.4	0.0	0.0
Helena	4,110	87	112	25.77	29.90	+.02	60.6	+1.4	90	25	72	40	2	49	44	50	42	55	1.00	−1.1	10	5,959	sw.	36	sw.	26	6	12	12	6.1	0.0	0.0
Kalispell	2,973	48	56	26.88	29.89	.00	58.8	+1.1	85	25	70	33	1	48	42	50	44	65	1.72	0.0	13	4,106	nw.	25	n.	29	8	16	6	5.0	0.0	0.0
Miles City	2,371	48	55	27.43	29.95	+.10	64.0	−2.0	97	26	75	43	4	53	35	56	51	66	1.72	−1.0	15	4,228	se.	36	nw.	8	10	14	6	4.7	0.0	0.0
Rapid City	3,259	50	58	26.59	29.96	+.11	61.6	−2.6	96	23	71	39	14	52	41	54	50	67	2.89	−0.7	18	5,801	s.	32	n.	17	7	9	14	6.5	0.0	0.0
Cheyenne	6,088	84	101	24.04	29.90	+.06	58.9	−1.5	91	24	70	36	13	47	45	49	43	63	2.02	+0.4	15	8,126	s.	56	w.	18	4	10	16	7.1	0.0	0.0
Lander	5,372	60	68	24.64	29.89	+.04	61.8	+1.3	91	25	74	41	1	50	40	50	41	53	2.25	+1.1	10	4,538	e.	50	sw.	23	8	18	4	4.7	0.0	0.0
Sheridan	3,790	10	47	26.07	29.92		60.0		97	26	72	36	2	48	40	53	48	70	2.90		11	3,533	nw.	37	sw.	26	7	15	8	5.7	0.0	0.0
Yellowstone Park	6,241	11	48	23.90	29.91	+.05	54.4	−1.6	85	25	67	30	2	42	40	46	40	65	1.02	−0.6	15	5,549	s.	37	s.	8	6	20	4	5.3	0.0	0.0
North Platte	2,821	11	51	27.05	29.93	+.07	66.4	−1.1	101	24	77	43	12	56	38	58	53	67	4.51	+1.3	11	5,421	s.	27	n.	20	12	5	13	5.4	0.0	0.0
Middle Slope							70.5	−1.4										64	3.96	+0.8										5.7		
Denver	5,292	106	113	24.74	29.90	+.06	64.6	−1.7	95	26	76	43	13	53	40	53	45	58	2.76	+1.3	15	5,358	s.	40	n.	21	5	14	11	6.2	0.0	0.0
Pueblo	4,685	80	86	25.28	29.87	+.04	68.8	−0.2	100	24	82	45	13	56	43	54	45	52	1.89	+0.4	8	5,535	e.	38	w.	20	10	14	6	5.0	0.0	0.0
Concordia	1,392	50	58	28.48	29.93	+.03	70.4	−2.6	96	27	80	49	12	61	30	62	58	69	5.82	+0.8	12	6,132	s.	30	ne.	3	9	12	9	5.7	0.0	0.0
Dodge City	2,509	11	51	27.38	29.94	+.07	71.0	−1.5	101	24	83	47	13	59	33	61	56	66	3.69	+0.4	12	7,708	se.	46	nw.	2	17	6	7	3.9	0.0	0.0
Wichita	1,358	139	158	28.51	29.92	+.01	72.5	−1.9	93	11	82	53	14	63	27	64	60	70	4.66	−0.1	9	9,394	s.	46	nw.	2	15	10	5	4.0	0.0	0.0
Broken Arrow	765	11	56	29.14	29.96		73.8		94	26	83	56	15	65	26				4.44		12	8,233	s.	60	n.	18	12	8	10	4.8	0.0	0.0
Oklahoma City	1,214	10	47	28.67	29.92	+.01	75.8	−0.2	98	26	86	56	14	66	29	67	64	71	4.95	+1.9	9	7,066	s.	30	n.	5	15	6	9	4.4	0.0	0.0
Southern Slope							77.5	−0.4										56	1.70	−0.9										3.8		
Abilene	1,738	10	52	28.14	29.90	+.02	80.2	+1.0	103	2	92	58	14	69	32	67	61	60	0.89	−2.3	7	7,694	s.	44	s.	19	12	16	2	4.0	0.0	0.0
Amarillo	3,676	10	49	26.26	29.90	+.05	73.8	+1.0	102	9	88	47	13	60	38	60	52	56	1.51	−1.5	6	7,546	s.	30	n.	20	18	8	4	3.3	0.0	0.0
Del Rio	944	64	71	28.89	29.85	.00	81.0	−2.4	100	10	90	64	6	71	30	70	66	65	2.40	0.0	8	7,448	se.	50	nw.	13	9	9	12	5.5	0.0	0.0
Roswell	3,566	75	85	26.32	29.84	+.04	75.0	−1.3	101	9	89	49	4	61	42	58	45	45	2.00	+0.2	6	6,206	s.	35	nw.	15	22	6	2	2.6	0.0	0.0
Southern Plateau							74.1	−0.1										38	0.70	+0.4										2.4		
El Paso	3,778	152	175	26.12	29.79	+.04	80.8	+1.2	99	17	93	56	12	68	31	58	41	31	0.10	−0.4	2	7,982	e.	48	w.	2	20	9	1	2.7	0.0	0.0
Santa Fe	7,013	38	53	23.30	29.82	+.01	64.3	−0.5	89	25	77	38	3	52	35	49	36	44	3.28	+2.2	9	4,567	se.	29	sw.	27	15	10	5	4.0	0.0	0.0
Flagstaff	6,907	10	59	23.37	29.81	+.03	58.2	−1.1	87	25	74	31	1	42	45	44		47	1.19		8		sw.	33	s.	2	15	11	4			
Phoenix	1,108	10	82	28.62	29.74	.00	83.7	−0.8	111	24	99	57	3	68	43	60	42	30	0.13	0.0	3	3,975	w.	25	w.	10	23	4	3	2.2	0.0	0.0
Yuma	141	9	54	29.60	29.74	.00	84.4	−0.3	112	23	101	58	1	67	42	64	49	37	0.00	0.0	0	3,604	sw.	23	nw.	1	28	2	0	0.7	0.0	0.0
Independence	3,957	5	25	25.86	29.80	+.02	73.2	+0.9	102	23	91	45	3	55	46	52			0.00	−0.1	0		nw.				18	10	2		0.0	0.0
Middle Plateau							66.7	+1.5										41	0.93	+0.4										3.5		
Reno	4,532	74	81	25.43	29.86	.00	64.4	+3.4	94	21	80	39	27	49	43	49	37	45	0.26	−0.1	3	4,950	w.	44	w.	7	19	9	2	3.0	0.0	0.0
Tonopah	6,090	12	20				67.2		90	22	79	38	28	55	31	49	33	31	T.		0		nw.									
Winnemucca	4,344	18	56	25.57	29.90	+.02	64.6	+1.8	92	25	81	37	27	48	43	51	42	53	1.25	+0.6	6	4,636	ne.	39	w.	7	19	11	0	3.3	0.0	0.0
Modena	5,473	10	43	24.57	29.80	−.02	65.0	+1.7	92	23	82	35	3	49	44	47	30	35	0.43	0.0	3	8,934	sw.	54	s.	27	18	11	1	2.9	0.0	0.0
Salt Lake City	4,360	163	203	25.55	29.84	−.01	68.8	+1.4	97	25	80	44	1	58	33	52	40	40	0.89	+0.1	3	5,802	nw.	48	nw.	18	17	7	6	3.8	0.0	0.0
Grand Junction	4,602	60	68	25.33	29.84	+.01	70.8	−0.6	99	25	83	44	1	58	34	54	41	43	1.81	+1.4	9	5,121	se.	33	w.	17	14	10	6	4.3	0.0	0.0
Northern Plateau							65.2	+1.6										54	1.43	+0.3										5.1		
Baker	3,471	48	53	26.42	29.97	+.02	59.4	+0.8	85	25	72	38	1	47	37	51	45	65	1.90	+0.7	9	3,433	se.	30	se.	8	8	15	7	5.3	0.0	0.0
Boise	2,739	78	86	27.10	29.91	.00	66.2	+0.9	96	25	80	42	1	52	35	54	45	54	0.80	−0.1	3	3,500	se.	25	s.	26	14	9	7	4.2	0.0	0.0
Lewiston	757	40	48	29.11	29.91	−.03	67.8	+1.2	92	21	81	46	2	54	38				1.90	+0.9	7	2,212	e.	23	s.	16	9	11	10	5.7	0.0	0.0
Pocatello	4,477	60	68	25.42	29.86	−.01	64.6	+2.4	94	25	78	38	1	51	39	50	38	45	0.77	−0.2	3	5,185	sw.	36	sw.	16	10	19	1	4.2	0.0	0.0
Spokane	1,929	101	110	27.90	29.92	−.02	64.3	+1.5	87	7	76	45	1	53	33	54	46	58	0.98	−0.3	9	3,706	s.	27	w.	8	7	12	11	6.2	0.0	0.0
Walla Walla	991	57	65	28.86	29.92	−.04	69.2	+2.7	96	21	80	52	30	58	36	56	45	47	2.22	+1.0	7	3,555	s.	20	w.	29	12	13	5	4.8	0.0	0.0
North Pacific Coast Region							60.3	+1.9										71	1.30	−0.6										6.8		
North Head	211	11	56	29.82	30.05	+.06	55.5	+0.7	67	20	59	50	1	52	16	53	51	88	1.44	−0.5	13	10,860	n.	67	s.	25	0	5	25	8.8	0.0	0.0
Port Angeles	29	8	53		30.05		56.7		77	6	64	45	26	49	28				0.77	−0.5	6	4,887	sw.	36	w.	28	5	14	11		0.0	0.0
Seattle	125	215	250	29.87	30.00	.00	61.5	+2.5	85	20	70	47	2	54	29	54	49	68	0.37	−1.0	8	4,975	ne.	36	sw.	25	5	11	14	6.6	0.0	0.0
Tacoma	194	172	201	29.82	30.02	−.01	62.2	+3.5	84	20	70	47	2	54	31				0.75	−0.9	6	5,586	n.	42	s.	25	5	14	11	6.3	0.0	0.0
Tatoosh Island	86	9	53	29.94	30.04	+.02	53.3	+0.3	67	6	56	48	26	50	17	51	50	91	2.38	−1.8	14	6,095	s.	69	s.	25	5	6	19	7.4	0.0	0.0
Yakima	1,071	5					68.0		92	6	82	46	20	54	43	55		52	0.16		2		nw.									
Medford	1,425	4					65.7		93	20	81	42	1	50	43	55	49	66	0.43		5		nw.									
Portland, Oreg.	153	68	106	29.85	30.01	−.03	64.4	+2.0	92	20	74	46	2	55	34	57	51	66	2.68	+1.0	8	3,795	nw.	26	s.	7	4	10	16	6.8	0.0	0.0
Roseburg	510	9	57	29.46	30.01	−.02	65.2	+2.7	94	20	79	41	2	52	45	56	50	65	0.69	−0.4	8	2,356	n.	17	nw.	30	7	14	9	5.5	0.0	0.0
Middle Pacific Coast Region							65.4	+1.0										68	0.51	+0.1										3.4		
Eureka	62	73	89	29.98	30.05	.00	55.4	+1.1	66	24	60	49	19	51	14	52	50	87	0.91	−0.2	4	4,811	n.	31	n.	28	4	15	11	6.5	0.0	0.0
Red Bluff	332	50	56	29.51	29.86	−.02	76.0	+1.2	102	15	90	50	27	62	38	60	49	46	0.50	0.0	2	4,552	nw.	27	nw.	28	25	4	1	2.1	0.0	0.0
Sacramento	69	106	117	29.79	29.86	−.03	70.6	+1.2	101	15	85	48	1	56	38	59	52	60	0.57	+0.4	1	6,243	s.	25	nw.	28	23	6	1	1.6	0.0	0.0
San Francisco	155	208	243	29.76	29.93	−.03	59.8	+1.3	93	30	66	49	1	53	35	54	51	80	0.38	+0.2	1	6,359	w.	32	w.	22	13	10	7	4.7	0.0	0.0
San Jose	141	12	110	29.79	29.94		65.4	+0.4	98	30	78	46	1	52	40				0.19	+0.1	1	5,107	nw.	22	nw.	23	22	7	1	2.3	0.0	0.0
South Pacific Coast Region							66.4	−0.6										68	0.99	0.0										3.6		
Fresno	327	89	98	29.51	29.85	.00	75.2	−0.6	101	15	91	51	27	60	38	58	45	42	0.12	0.0	1	6,416	nw.	48	nw.	7	25	5	0	1.0	0.0	0.0
Los Angeles	338	159	191	29.55	29.92	+.02	65.0	−1.4	87	24	73	52	2	57	28	58	55	77	T.	−0.1	0	3,505	sw.	16	sw.	27	13	12	5	4.6	0.0	0.0
San Diego	87	62	70	29.82	29.91	−.01	63.3	−0.6	75	25	68	55	7	59	19	59	56	82	0.12	+0.1	2	4,513	w.	21	s.	25	7	16	7	5.6	0.0	0.0
San Luis Obispo	201	32	40	29.74	29.96	+.01	62.2	0.0	89	22	73	47	1	51	39	53	49	72	0.12	0.0	2	3,188	nw.	22	ne.	26	19	8	3	3.1	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.93	30.01		79.3	−0.4	90	30	84	71	23	74	16				8.67	+2.8	20	9,709	e.	34	e.	14	6	14	10	6.1	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.73	29.85	+.01	79.3	−0.8	89	8	85	71	30	74	16	76	75	89	10.83	+2.8	22	3,724	nw.	28	sw.	29	1	12	17	7.6	0.0	0.0
Colon	38	7	97	29.81	29.85	.00	81.4	+1.0	91	24	88	73	2	75	17	76	75	84	13.74	0.0	23	4,846	s.	22	w.	5	0	5	25	8.7	0.0	0.0
Alaska																																
Juneau	80	11	54	[1] 29.88	[1] 29.97		55.0		73	21	62	38	1	48	28	50	46	74	1.86		16	3,807	s.	30	nw.	30	3	6	21	7.8	0.0	0.0
Hawaiian Islands																																
Honolulu	38	86	100	[1] 30.00	[1] 30.04		77.4		85	26	82	69	6	73	13	69	65	68	0.24	−0.7	7	6,995	e.	28	ne.	6	10	18	2	4.6	0.0	0.0

[1] Pressure not corrected to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, June, 1927*

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+ mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	*In.*	*In.*	*In.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*In.*	*In.*	*In.*
St. Johns, N. F.	125												
Sydney, C. B. I.	48												
Halifax, N. S.	88												
Yarmouth, N. S.	65												
Charlottetown, P. E. I.	38												
Chatham, N. B.	28												
Father Point, Que.	20												
Quebec, Que.	296	29.62	29.94	+0.02	59.3	−1.9	70.1	48.5	85	38	3.27	−0.38	0.0
Montreal, Que.	187	29.73	29.93	−.01	61.7	−3.2	70.9	52.5	86	44	4.34	+0.81	0.0
Stonecliffe, Ont.	489												
Ottawa, Ont.	236	29.69	29.95	+.01	61.3	−4.0	72.4	50.3	87	40	4.19	+1.27	0.0
Kingston, Ont.	285	29.66	29.97	.00	59.3	−4.1	66.7	51.9	80	41	2.39	−0.04	0.0
Toronto, Ont.	379	29.57	29.97	.00	61.5	−1.9	72.2	50.8	95	39	2.52	−0.28	0.0
Cochrane, Ont.	930				54.0		67.7	40.4	98	21	2.86		0.0
White River, Ont.	1,244	28.59	29.90	−.04	53.0	−5.7	66.3	39.8	92	26	1.84	−0.38	0.0
Port Stanley, Ont.	592												
Southampton, Ont.	656	29.28	29.99	+.02	56.7	−3.7	67.1	46.4	86	34	3.11	+0.76	0.0
Parry Sound, Ont.	688	29.28	29.96	.00	57.3	−4.4	68.0	46.7	84	37	4.41	+1.99	0.0
Port Arthur, Ont.	644	29.23	29.94	.00	55.0	−1.4	64.1	45.9	86	39	3.03	+0.30	0.0
Winnipeg, Man.	760												
Minnedosa, Man.	1,690	28.10	29.89	.00	58.4	−1.2	69.1	47.7	82	32	1.05	−1.95	0.0
Le Pas, Man.	860				55.8		67.0	44.6	79	25	0.73		0.0
Qu'Appelle, Sask.	2,115	27.64	29.85	−.02	59.4	−0.5	72.0	46.8	83	29	1.16	−2.26	0.0
Medicine Hat, Alb.	2,144												
Moose Jaw, Sask.	1,759				61.8		74.8	48.8	88	34	0.88		0.0
Swift Current, Sask.	2,392	27.34	29.81	−.06	61.0	+1.0	74.9	47.1	90	36	1.11	−1.56	0.0
Calgary, Alb.	3,428												
Banff, Alb.	4,521												
Edmonton, Alb.	2,150												
Prince Albert, Sask.	1,450	28.35	29.91	+.04	58.2	+0.5	70.1	46.3	83	32	2.46	−0.05	0.0
Battleford, Sask.	1,592	28.16	29.88	+.02	59.9	+0.4	72.3	47.5	88	34	1.35	−1.96	0.9
Kamloops, B. C.	1,262												
Victoria, B. C.	230												
Barkerville, B. C.	4,180												
Triangle Island, B. C.	680												
Prince Rupert, B. C.	170												
Hamilton, Ber.	151												

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Cochrane, Ont.	930				42.5		55.4	29.6	69	18			
Kamloops, B. C.	1,262	28.67	29.95	+.06	55.7	−3.4	67.5	44.0	81	37	1.26	+0.02	0.0
Barkerville, B. C.	4,180	25.64	29.95	+.11	41.7	−3.8	52.5	30.9	67	23	1.88	−0.64	11.0
Prince Rupert, B. C.	170				48.2		55.0	41.5	68	34	3.58		0.0

Chart I. Tracks of Centers of Anticyclones, June, 1927. (Inset.) Departure of Monthly Mean Pressure from Normal (Plotted by Wilfred P. Day.)

Chart I. Tracks of Centers of Anticyclones, June, 1927. (Inset) **Departure of Monthly Mean Pressure from Normal**

(Plotted by Wilfred P. Day)

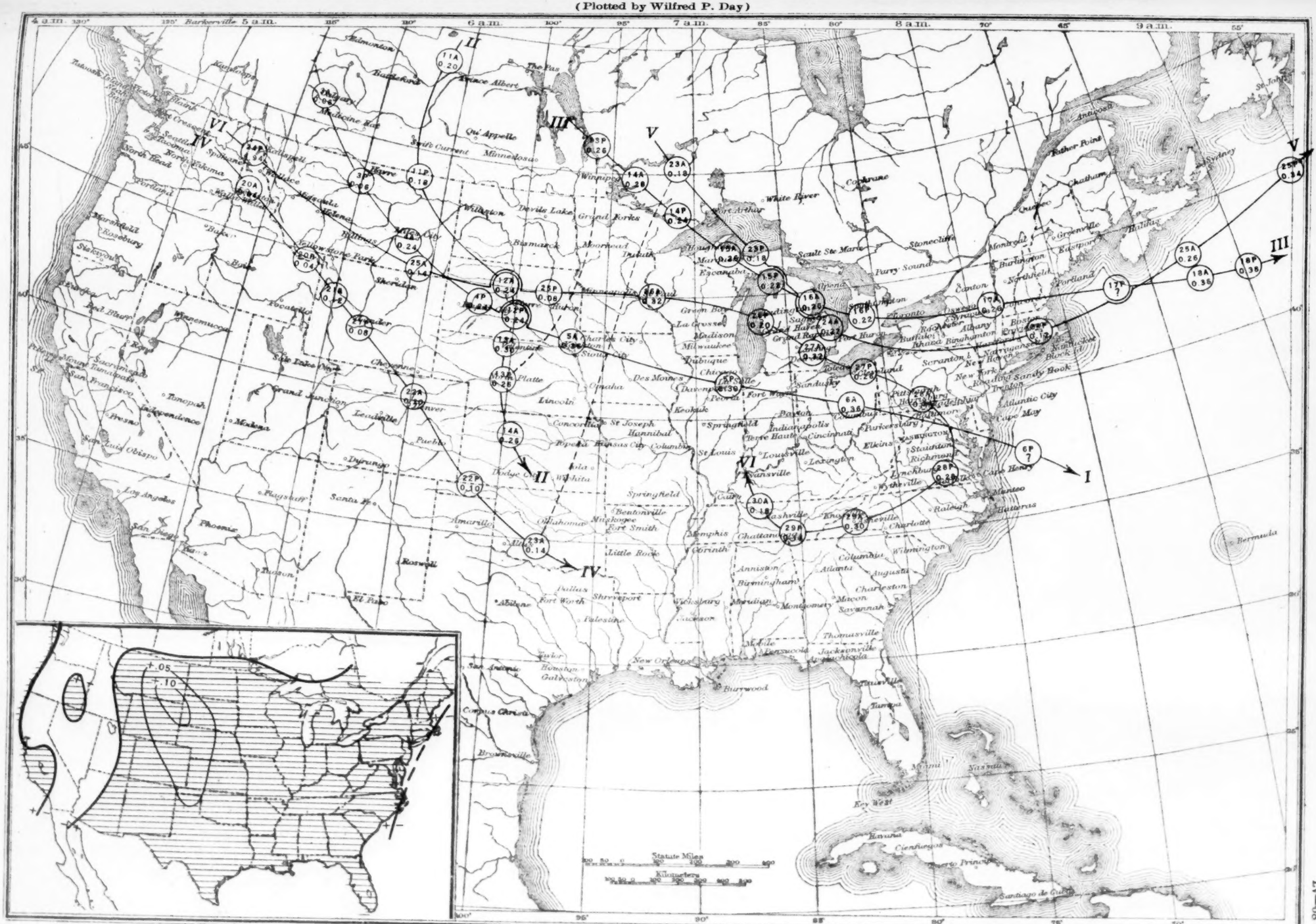


Chart II. Tracks of Centers of Cyclones, June, 1927. (Inset) **Change in Mean Pressure from Preceding Month**

(Plotted by Wilfred P. Day)

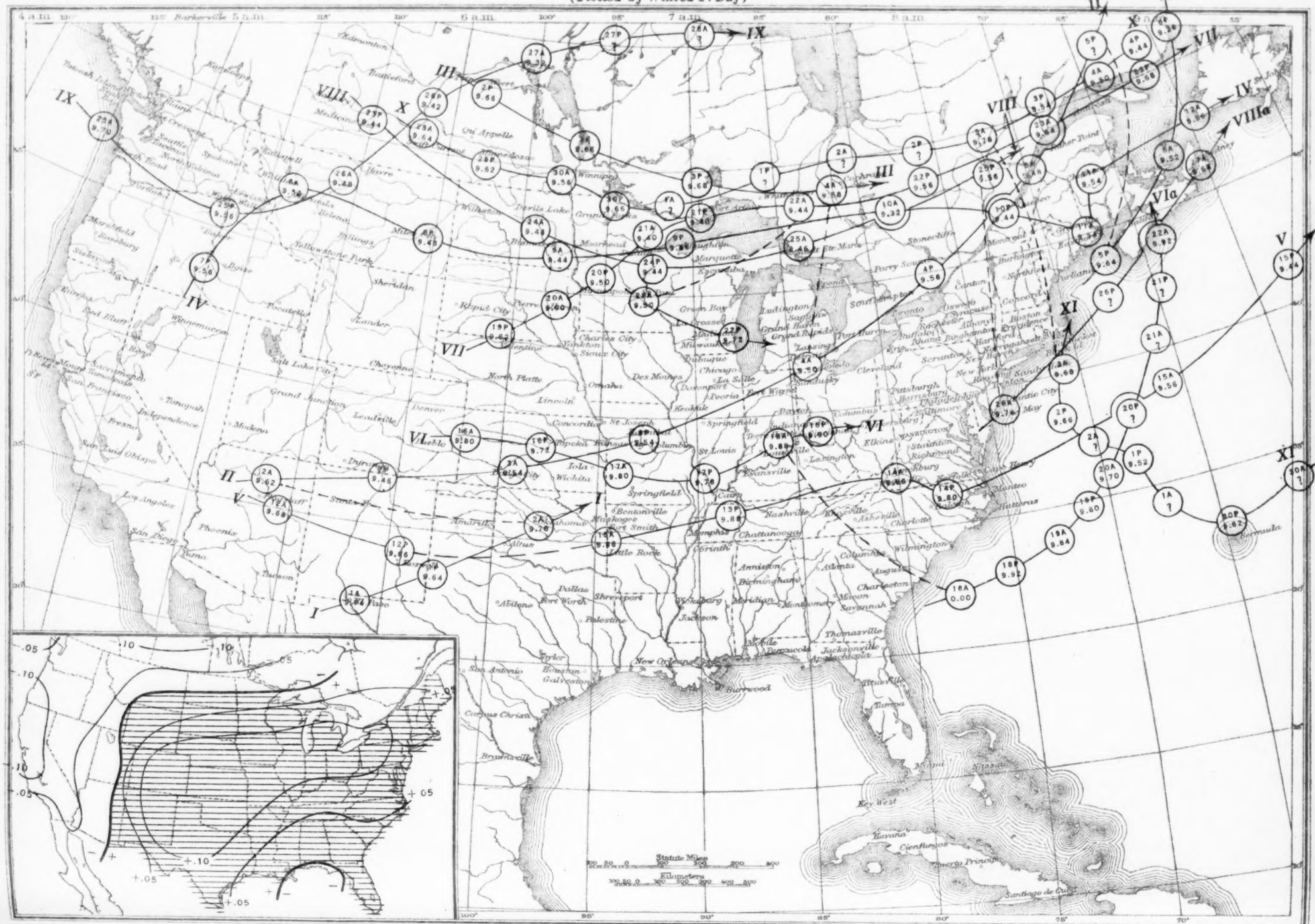


Chart III. Departure (°F.) of the Mean Temperature from the Normal, June, 1927

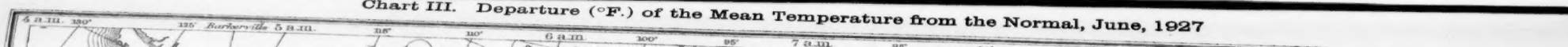


Chart III. Departure (°F.) of the Mean Temperature from the Normal, June, 1927

Shaded portions show excess (+).
Unshaded portions show deficiency (—).
Lines show amount of excess or deficiency.
Statute Miles
Kilometers

Chart IV. Total Precipitation, Inches, June, 1927. (Inset) Departure of Precipitation from Normal

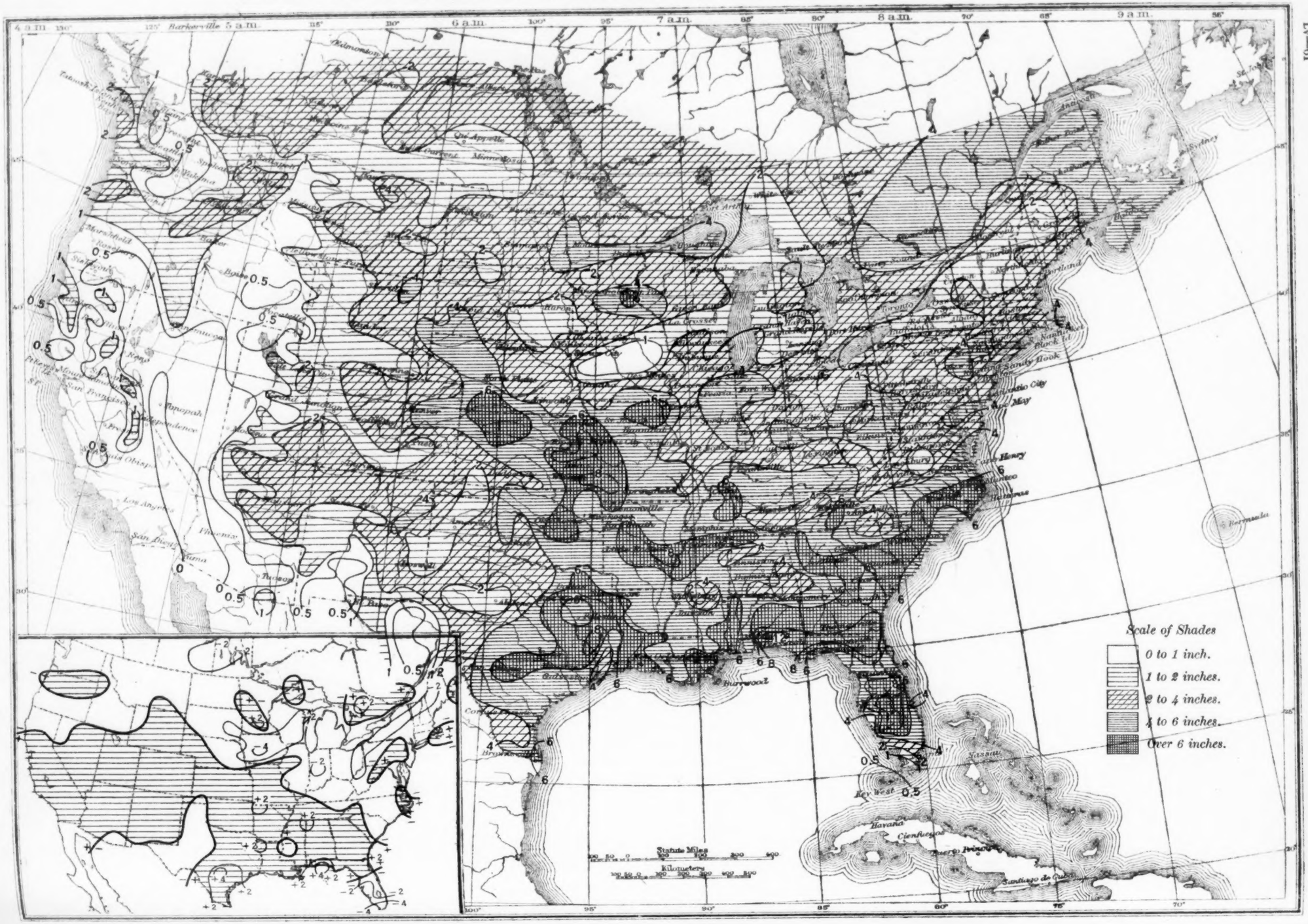


Chart V. Percentage of Clear Sky between Sunrise and Sunset, June, 1927

Chart V. Percentage of Clear Sky between Sunrise and Sunset, June, 1927

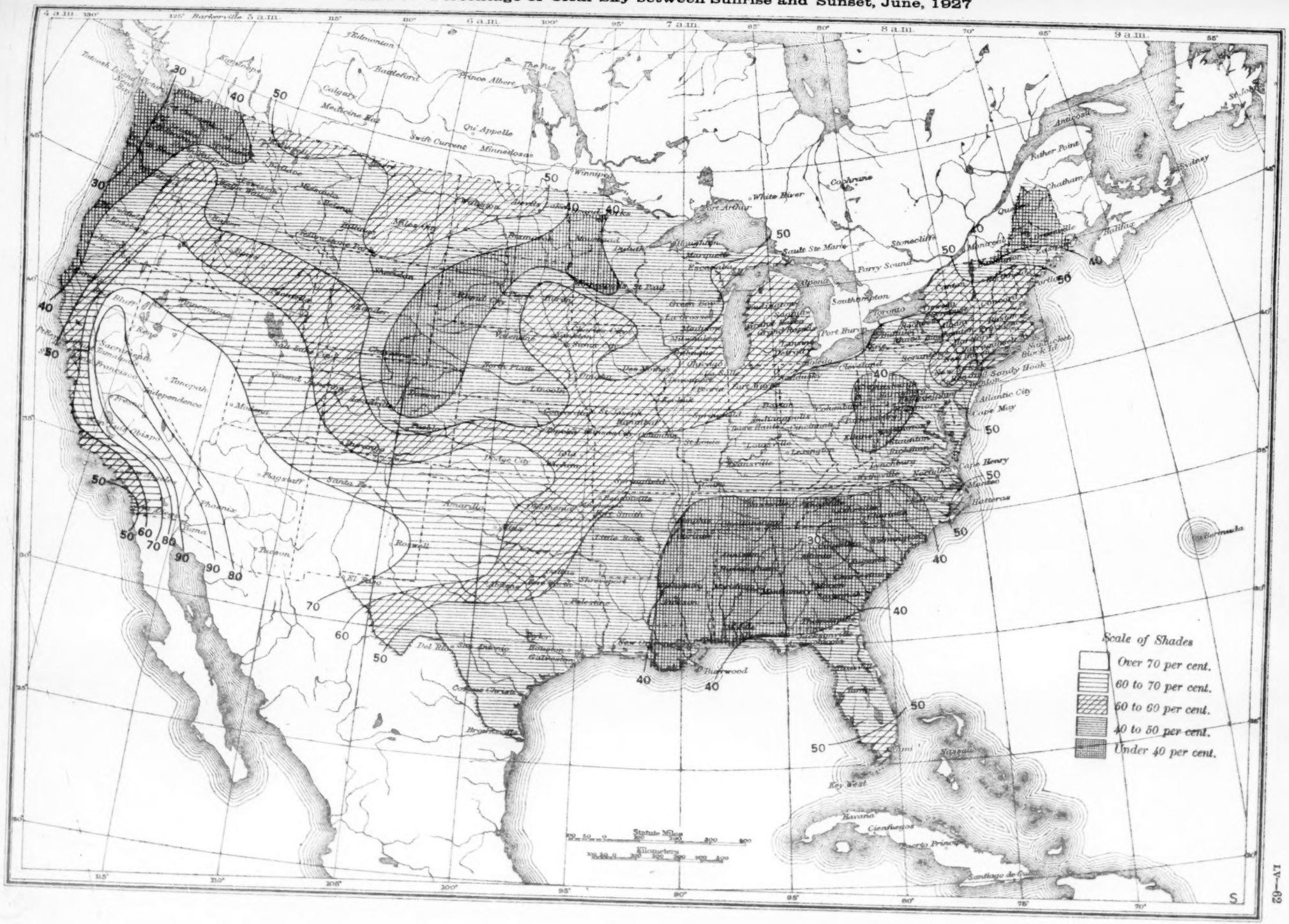


Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, June, 1927

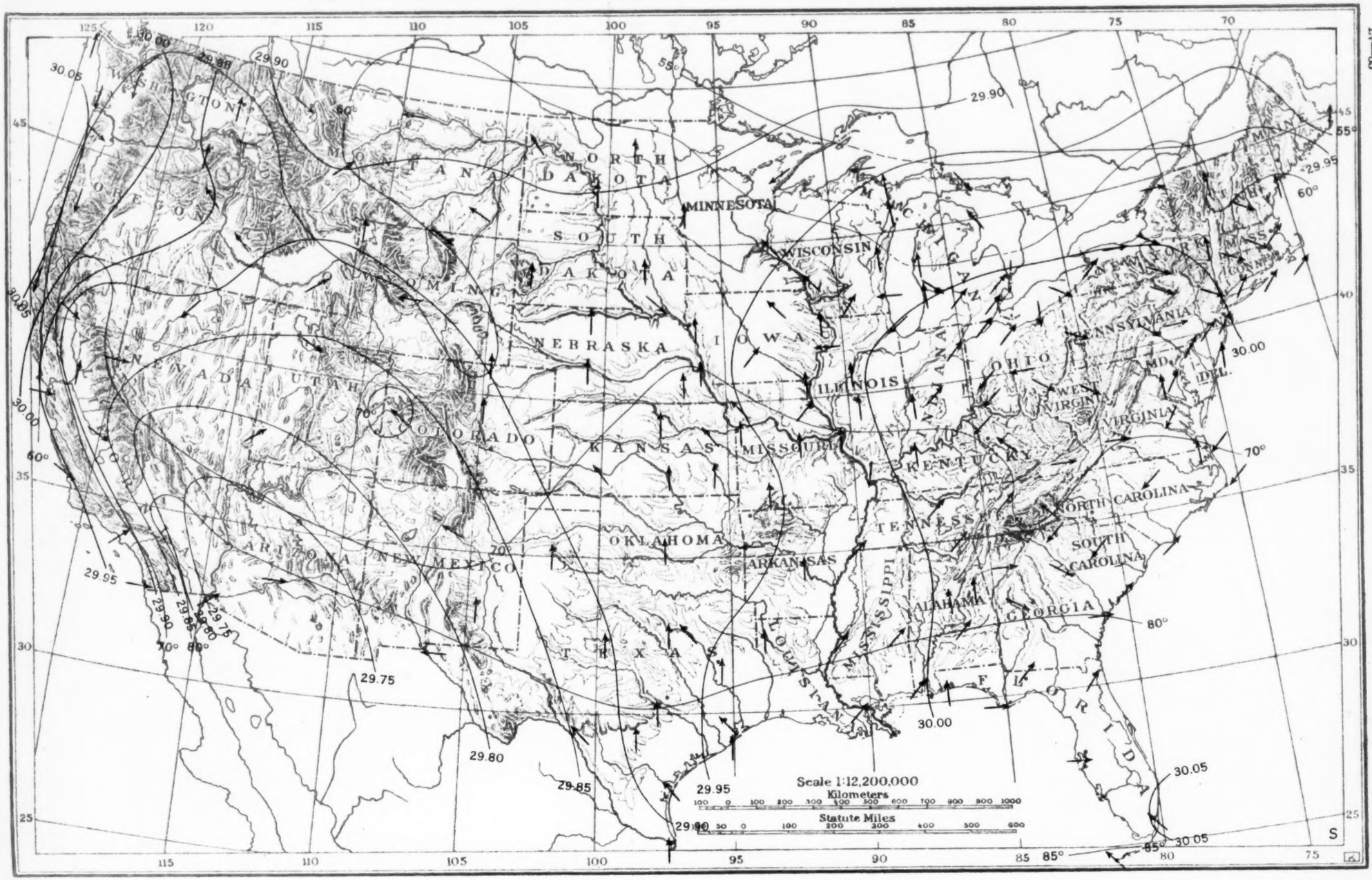


Chart VIII. Weather Map of North Atlantic Ocean, June 4, 1927

(Plotted by F. A. Young)

Chart VIII. Weather Map of North Atlantic Ocean, June 4, 1927

(Plotted by F. A. Young)

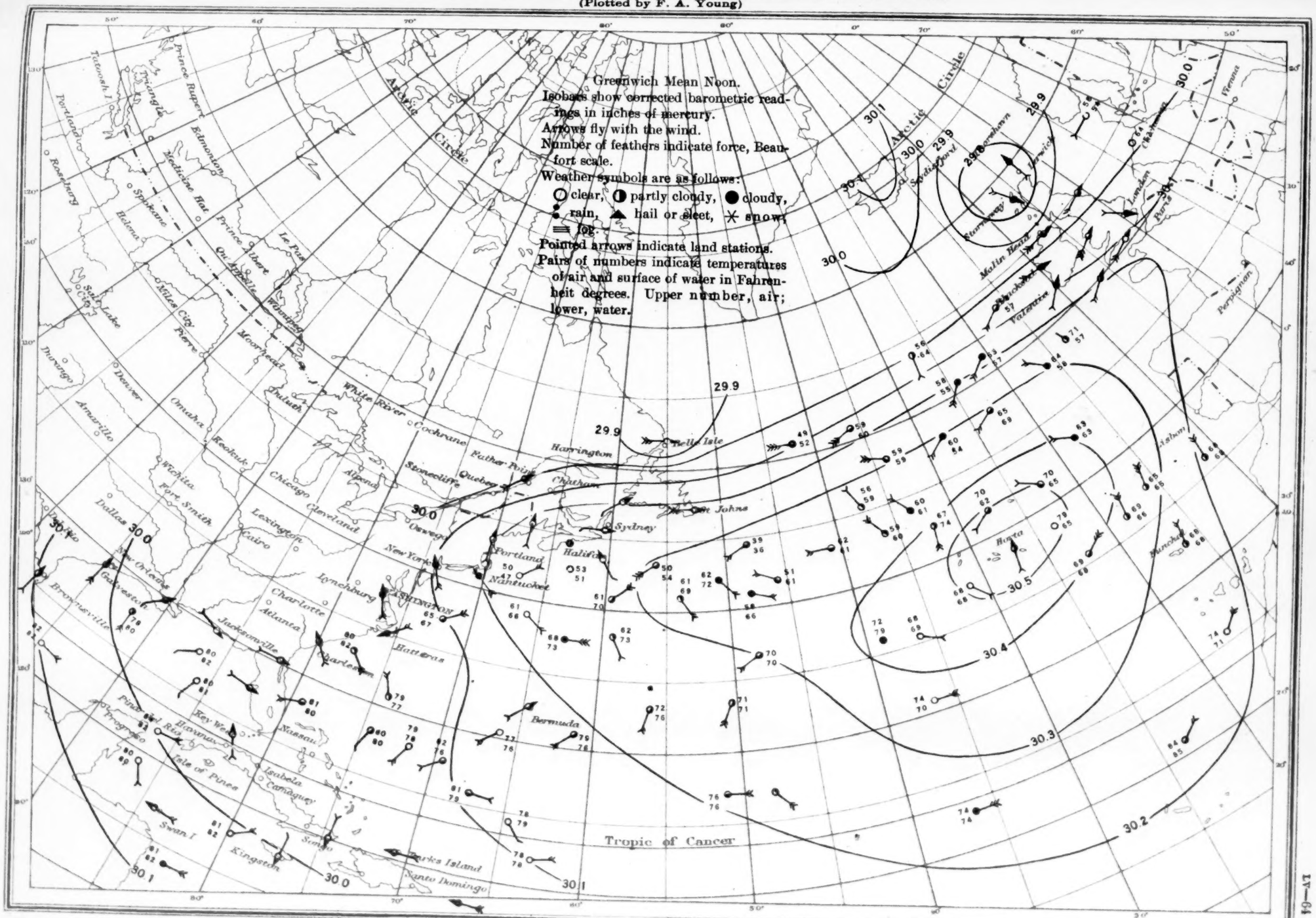


Chart IX. Weather Map of North Atlantic Ocean, June 5, 1927

(Plotted by F. A. Young)

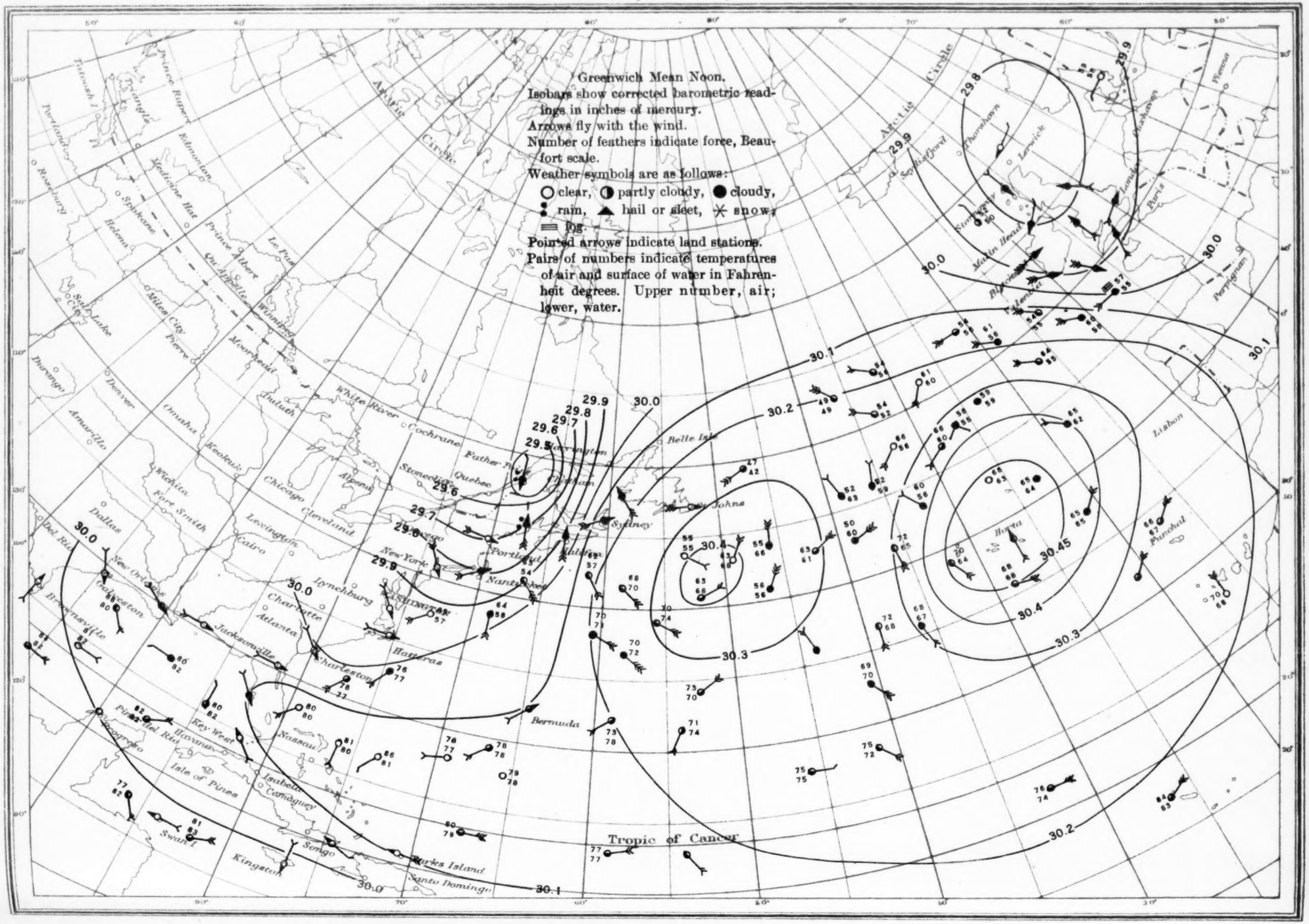


Chart X. Weather Map of North Atlantic Ocean, June 29, 1927

(Plotted by F. A. Young)

Chart X. Weather Map of North Atlantic Ocean, June 29, 1927
(Plotted by F. A. Young)

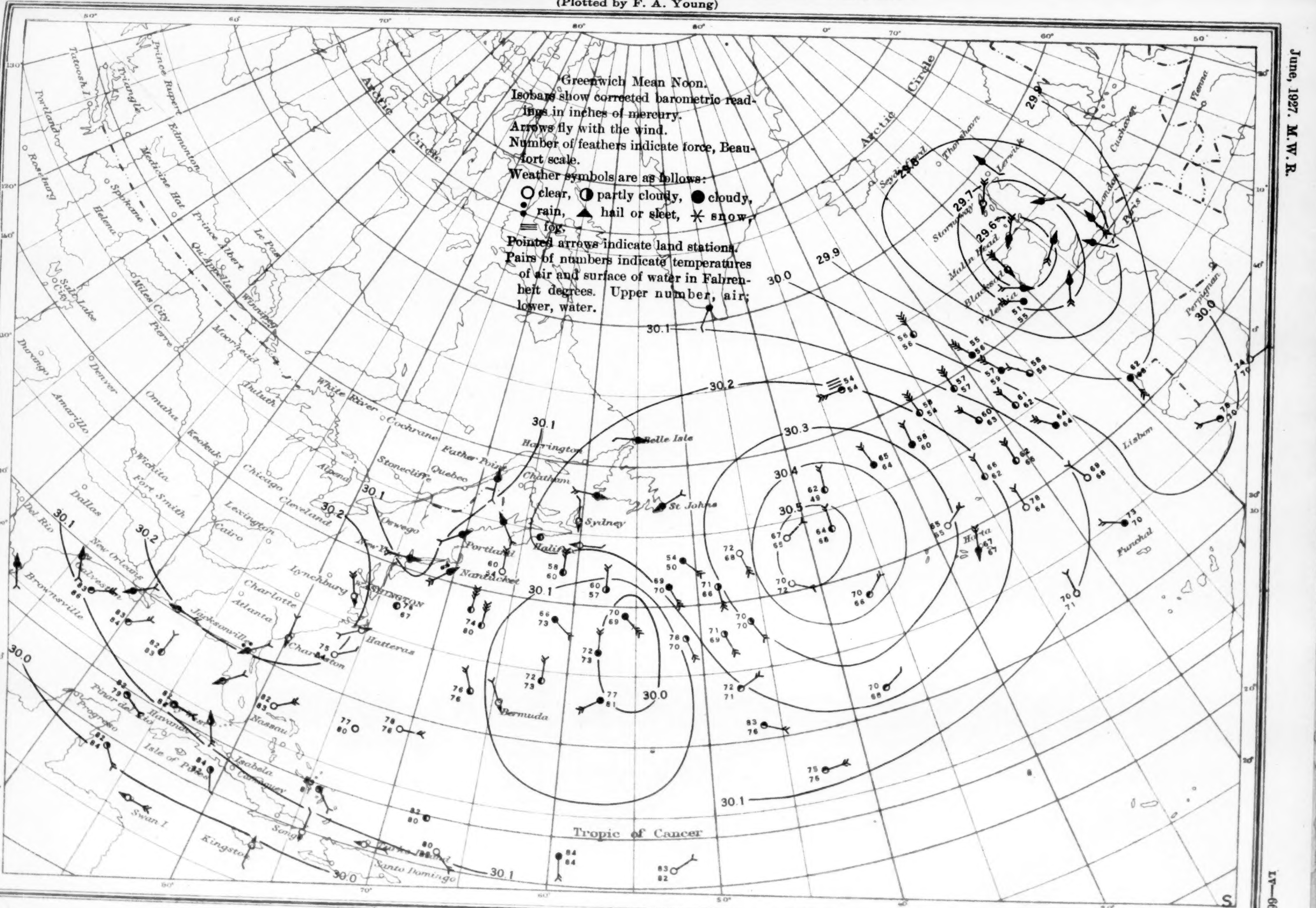
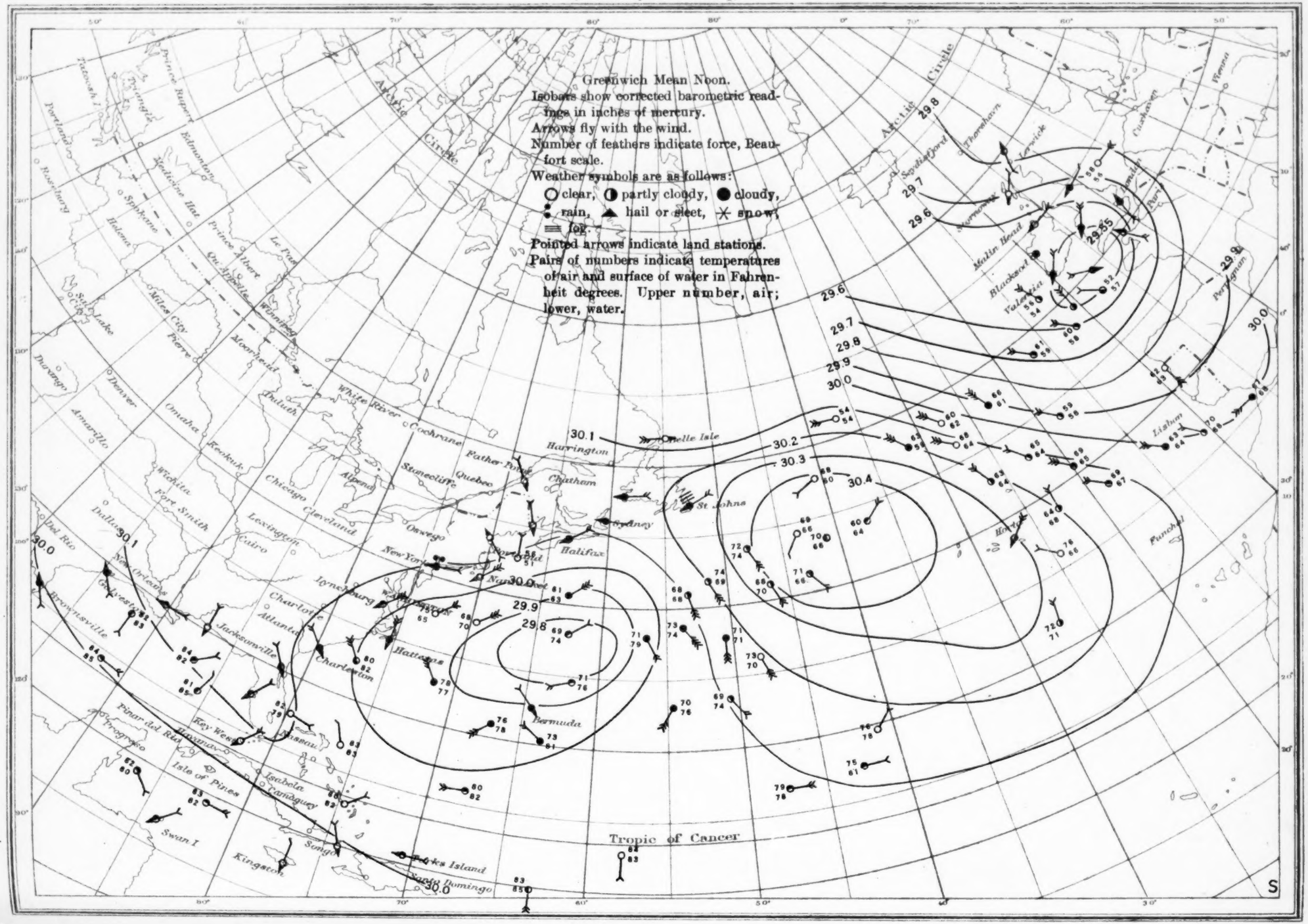


Chart XI. Weather Map of North Atlantic Ocean, June 30, 1927

(Plotted by F. A. Young)